Safety Performance Measurements: A PC-Based Evaluation Tool for Industrial Contractors in Saudi Arabia

by

Mohamed Ali Saleh Bu-Khamsin

A Thesis Presented to the

FACULTY OF THE COLLEGE OF GRADUATE STUDIES

KING FAHD UNIVERSITY OF PETROLEUM & MINERALS

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In Partial Fulfillment of the
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SAFETY PERFORMANCE MEASUREMENTS: A PC-BASED EVALUATION TOOL FOR INDUSTRIAL CONTRACTORS IN SAUDI ARABIA

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DEANSHIP OF GRADUATE STUDIES

This thesis, written by **MOHAMED ALI SALEH BU-KHAMSIN** under the direction of his Thesis Advisor and approved by his Thesis Committee, has been presented to and accepted by the Dean of Graduate Studies, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN CONSTRUCTION ENGINEERING & MANAGEMENT.**

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Dedicated to My Beloved Parents,
Wife and Children who are the source
of my inspiration, encouragement,
guidance and happiness

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I express my special gratitude and remain ever in debt to my mother, who made faithful Duaa to Allah during her prayer for my success and completion of the thesis. I also express my sincere appreciation to my wife for her kindness, understanding, encouragement, unlimited patience and generous support during my studies and research period. Thanks to my sons for giving me enjoyment and happiness during the difficult time of this research. I am particularly grateful to my brothers and sisters for their encouragement, support and continual reassurance that enabled me to accomplish my goals.

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THESIS ABSTRACT

NAME OF STUDENT: Mohamed Ali Saleh Bu-Khamsin

TITLE OF STUDY: Safety Performance Measurements: A PC-Based Evaluation Tool for Industrial Contractors in Saudi Arabia

MAJOR FIELD: Construction Engineering and Management

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This thesis presents a structured and systematic approach that will help the industrial construction contractor in Saudi Arabia to monitor and measure his construction safety performance. The research began with an analysis of the factors which influence the process of safety performance measurement as it is currently practiced in general by the construction industry. This analysis is based on a review of the literature and formal interviews with the contractors' officials responsible for construction safety.

In the second phase, a survey was distributed to 25 Industrial Contractors in the Eastern Province of Saudi Arabia. The intent of the survey was to gather data on those significant factors which influence the safety performance measurement process. The survey consisted of 20 main factors and 85 sub-factors. Quantitative statistical analyses of these data were performed. Then, the main factors and sub-factors were ranked by their level of importance based on the survey results and analysis.

In the third phase, a PC-based evaluation tool for determining the safety performance of construction contractor was developed. Data arrived at during the second phase was utilized to build the evaluation tool. The tool uses a dimensional weighting approach for measuring safety performance. When applied in practice, this PC-based tool can provide industrial construction contractors in Saudi Arabia with a valuable device for safety performance measurement and monitoring.

Finally, in order to improve the measurements of the construction safety performance, a set of recommendations was made and topics for future research were suggested.

DEGREE OF MASTER OF SCIENCE
KING FAHD UNIVERSITY OF PETROLEUM AND MINERALS
FEBRUARY 1999

خلاصة الرسالة

اسم الطالب الكامل: محمد علي بن صالح محمد بوخمسين

عنوان الدراسة: نموذج منهجي لقياس أداء السلامة لمقاولي التشييد الصناعي في المملكة العربية السعودية باستخدام الحاسب الآلي

التخصص: هندسة و إدارة التشييد

تاريخ الشهادة: فبراير ١٩٩٩ ميلادية

تناقش هذه الرسالة نتائج بحث أجري عن عملية قياس أداء السلامة لمقاولي التشييد الصناعي في المملكة العربية السعودية و المعايير و العوامل المؤثرة في ذلك.

و تبدأ الرسالة في مرحلتها الأولى بعرض و تحليل العوامل المستخدمة حاليا في قطاع التشييد و المؤثرة في عملية قياس أداء السلامة. و قد اعتمدت هذه المرحلة على بعض المراجع بالإضافة إلى مقابلات أجريت مع مسؤلي السلامة لدى المقاولين. و في المرحلة الثانية تم توزيع استبيان على (٢٥) خمسة و عشرين شركة من شركات قطاع التشييد الصناعي في المنطقة الشرقية من المملكة العربية السعودية. و يتكون هذا الاستبيان من (٢٠) معيارا أساسيا و (٨٥) معيارا فرعيا, و قد تم أجراء تحليل كمي و نوعي على هذه المعايير ثم رتبت هذه المعايير حسب أهميتها في عملية القياس و ذلك وفقا لنتائج الاستبيان.

أما في المرحلة الثالثة فقد تم استخدام نتائج الاستبيان في تطوير برنامج عن طريق الحاسب الآلي لقياس أداء السلامة. و لتحسين مستوى أداء السلامة في التشييد. وأختتمت الرسالة بتقديم مجموعة من الاقتراحات و مواضيع للبحوث المستقبلية.

درجة الماجستير في العلوم

جامعة الملك فهد للبترول و المعادن

الظهران ، المملكة العربية السعودية

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CHAPTER ONE

INTRODUCTION

1.1 GENERAL

Saudi Arabia has experienced a construction boom during the past two decades, attracting construction professionals from all over the world. The construction industry was the greatest recipient of government spending during the First (1970-1975), Second (1975-1980) and Third (1980-1985) National Development Plans. It received 49.6 %, 32 %, and 49.8 % respectively of total government expenditure during the three 5-year plans. The construction industry in Saudi Arabia employs 15 % of the total labor force and accounts for 14 % of the total energy consumption in the country. It contributes about 20 % to the total non-oil gross domestic product (Al-Jarallah 1983).

In simplified terms, the principal parties involved in the development of construction projects are Owners, Designers, and Constructors. Once an owner recognizes the need for a project and deems it economically feasible and practical, the services of a designer are obtained. The designer considers the owner's ultimate needs concerning the project and sets out to complete the design. The constructor is then required to bridge the gap between the finished design and the finished project, ready for the owner's use. Each of

these parties plays an important and unique role in the process of project delivery (Hinze and Wiegand 1992).

One aspect of the construction phases that has been under persistent scrutiny for more years is the issue of construction worker safety. Owners, contractors, and regulatory agencies are obligated to help provide a safe work environment to minimize injuries. The owner cannot take a hands-off approach towards safety because construction activities take place on the owner's property. The owner needs an effective means by which to monitor and control safety during construction and to assess safety plans as one of the criteria for selecting a contractor. Contractors also need a tool by which to actively integrate safety and health measures into project planning (Kartam 1997).

Throughout the world, the construction area is one of the most hazardous industries (Suazo and Jaselskis 1993). The major causes of accidents are related to the unique nature of the industry, human behavior, difficult work-site conditions, and poor safety management, which result in unsafe work methods, equipment, and procedures.

However, safety is not a luxury, and may be considered an important function to be used against unnecessary loss of property, injury, or death. Preventing occupational injuries and illness should be a primary concern of all employers. In developing countries in particular, an effort must be made to raise the level of awareness among both

employees and employers of the importance of health and safety at work sites. Emphasis in both developing and developed countries should be placed on training and the utilization of comprehensive safety programs (Koehn, Kothari, and Pan 1995).

Project safety is a process in the construction industry, which is, for the most part, managed reactively and is the sole responsibility of the contractor (Hinze and Wiegand 1992). Schedule, cost, production, and quality control, on the other hand, are managed with well-thought-out computerized plans and controls at all levels controls at all level of responsibility. "Today, safety and health professionals realize that what is really needed is 'built-in,' 'integrated' safety, and not some artificially introduced program. Safety must be an integral part of the company's procedures" (Stanton and Willenbrock 1990).

Overall, the contractor must be concerned about the safety for the following reasons:

1.1.1 Humanitarian Concern

The suffering as a result of an accident both to injured parties and their families cannot be measured in economic terms. The contractor should never disregard this, even when the injured parties have been adequately compensated by insurance.

1.1.2 Economic Considerations

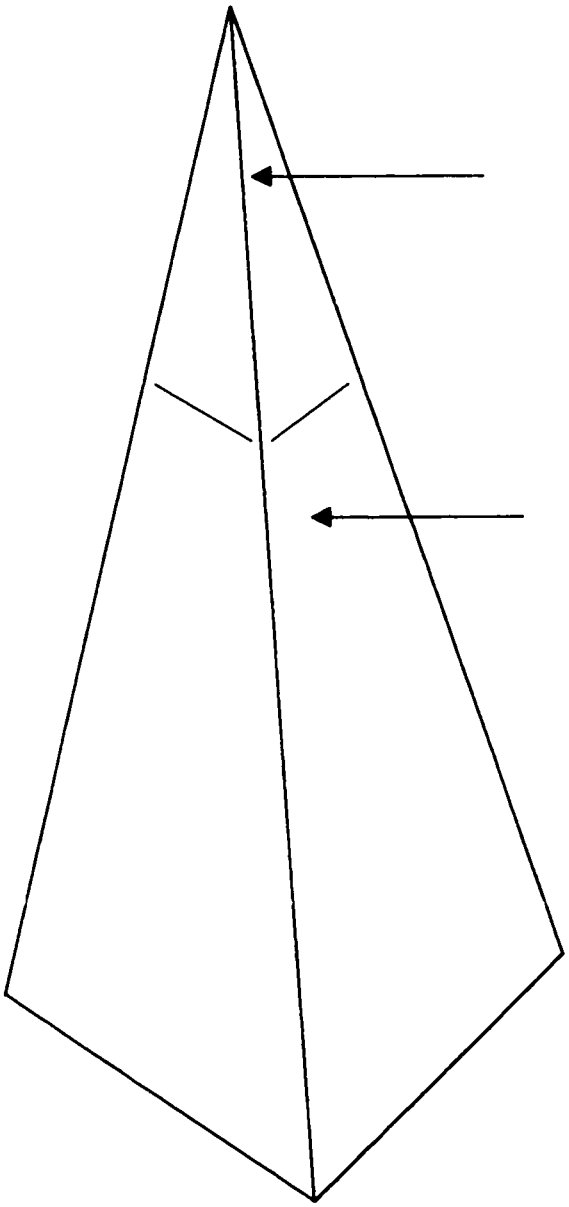
The contractor must realize that even with adequate insurance coverage, accidents will reduce company profits through the increased costs of future insurance premiums. Direct and indirect costs or hidden costs of accidents have been identified as shown in Fig. 1.1 (Davies and Tomasin 1990).

1.1.3 Legal Considerations

The Occupational Safety and Health Act of 1970 (OSHA) is a comprehensive set of safety and health regulations, inspection procedures, and record keeping requirements. OSHA requires that each employer provides to each of his employees a place of employment that is hazard free (Raouf and Dhillon 1994).

1.1.4 Company Image

A good safety record is a proven means of increasing worker morale and productivity. This in turn improves the company's public image, and therefore improves the company's bargaining position for negotiating future jobs.



DIRECT COSTS

- Medical
- Compensation

INDIRECT OR HIDDEN COSTS OF ACCIDENTS

- Time lost from work by injury
- Loss in earning power
- Economic loss to family of the injured person
- Lost time by fellow workers
- Loss of efficiency due to break-up of crew
- Lost time supervision
- Cost of breaking in new worker
- Damage to tools and equipment
- Time damaged equipment is out of service
- Spoiled work
- Loss of production
- Spoilage-fire, water, chemical, explosives
- Failure to fulfill orders
- Overhead costs (while work was disrupted)

Figure 1.1: Hidden Costs Of Accidents

Re-drawn from: Davies, V. J. and Tomasin, K., (1990). "Construction Safety Handbook". Thomas Telford, London.

1.2 PROBLEM STATEMENT

There are some factors which affect the safety performance level of the construction contractors, either positively or negatively. Among these factors are: Management Involvement, Proper Housekeeping, Health & Welfare, Proper Equipment & Tools, Safety Training, Personal Protective Equipment, Safety Programs, and Scaffolding.

The problem is to study those factors and find out which affects performance level and by how much.

Currently, most present indices of safety and health performance are based on an after-the-fact appraisal of injury-producing or property-damaging accidents or work-related illnesses. Some loss must be involved with a certain degree of severity, as defined by the reporting criteria, before an accident appears on a report form. What is needed is a method for examining accidents at the non-injurious state where the potential for loss is involved but where the loss has not yet actually occurred (Tarrants 1980).

The real problem is to find a criterion of safety effectiveness and some way of measuring it. Because lost-time and property-damaging accidents are rare events and first-aid cases are subject to serious reporting inaccuracies, the safety specialist is faced with only an intuitive notion about the effectiveness of various accident prevention methods. Despite the fact that measurement is so critical in accident loss control, the

majority of efforts in accident prevention have been concerned with the techniques of control, such as guard design, training, and so on. Little research has been devoted to the problem of how to evaluate the effectiveness of these control techniques.

To date, much of the safety research performance has addressed critical safety success factors by identifying factors that are important for safety success. There is a need for research that provides quantitative safety factors input associated with improved safety performance (Jaselskis, Anderson, and Russell 1996).

1.3 RESEARCH SIGNIFICANCE

The level of safety performance within an organization involves accident situations (unsafe acts / or unsafe conditions) that have the potential for producing loss but that do not necessarily produce a loss (either injury or property damage) each time they occur. In effect, then, measures of safety effectiveness that will enable us to identify accident problems that have the potential for producing future losses are needed as well as those that are currently producing property damage, injuries, and deaths.

Safety performance measurement will provide continuous information concerning changes in the contractor's safety state. A valid and reliable measure of these changes permits evaluation of the effectiveness of the contractor's accident prevention efforts over time. Because most safety measures are postmortem or after-the-fact in nature, they have

little but historical value. Therefore, a method for examining accidents at the non-injurious state where the potential for loss is involved but where the loss has not yet actually occurred will be much more meaningful, and hence, extremely important (Stevense 1958).

Generally measures are needed to reveal how well one is doing to answer the question "Did the accident prevention program pay off?" In a more specific sense, however, one must recognize that the main function of a measure of safety performance is to describe the safety level within an organization, establishment, or work unit. For this reason, the argument that injurious accidents in themselves are adequate measures of safety quality is open to serious question. Injurious accidents are one consequence of worker behavior within specified working conditions; as such, they reveal very little about antecedent behavior and machine-environment malfunctions that are important contributors to current and future accident problems. In effect, then, measures of safety performance must help prevent non-recorded accidents. They must be directional in time and space. They must describe when and where to expect trouble and must provide guidelines concerning what one should do about the problem.

A second purpose of a safety performance measure is to report continuously on the change in safety level within an organization and to evaluate the effects of accident prevention efforts as rapidly as possible. It should not be assumed that the mere recording of accidents brings a true picture of the existing safety level. For the most part,

the lack of safety instead of the presence of safety is measured when various techniques of safety performance evaluation are applied (Tarrants 1965).

Establishing quantified safety objectives is crucial to monitoring and measuring safety against minimum performance standards. By setting objectives and means of monitoring and measuring safety performance, responsibility for attaining objectives can be delegated to competent personnel who can be held accountable for them. With objectives identified and accountability established, management can focus on methods of statistical analysis to take corrective actions when variations from objectives occur. In such an environment, safety and health become proactive rather than reactive, i.e., the common practice of correcting mistakes is changed to correcting factors that lead to mistakes (Kartam 1997).

Since safety has been expressed as having been managed with reactive means, most safety and health professionals agree that a proactive approach is needed to improve safety performance. Simply stated, safety needs to be looked at and treated with the same kind of thoughtful project planning that goes into other project aspects. At the earliest stages of project development, construction and design professionals must be aware of relevant safety and health issues (Hinze 1993).

1.4 RESEARCH OBJECTIVES

The general objective of this research is to study the factors which affect the overall safety performance of the Industrial Construction Contractors in the Eastern Province of Saudi Arabia and find out the relationship, if any is indeed available. In addition, this research develops a PC-based tool for construction contractor safety performance measurement. This is to provide the contractors with a tool to plan the safety measures and integrate the safety concerns in the construction process; and provide the owners with a means to review a contractor's safety plan and monitor performance during construction.

Specifically, the objectives of this thesis are to:

A. Identify and analyze the factors which influence the safety performance of industrial construction contractors.

B. Investigate and survey the industrial construction organizations in the Eastern Province of Saudi Arabia to identify those factors which influence the measurement of the process of contractor safety performance.

C. Develop a PC-based evaluation tool to evaluate and monitor the safety performance of contractors.

1.5 RESEARCH SCOPE AND LIMITATIONS

The research scope is to study the factors which affect the overall safety performance of construction contractors. The research is limited to the industrial construction contractors in the Eastern Province of Saudi Arabia. This is because the industrial contractors are usually involved with large projects, and hence, they are exposed to more hazards and accidents. In addition, according to safety specialists and professionals (reference 12), industrial contractors are normally better organized than other contractors within the construction industry (i.e. public contractors).

The research is also restricted to the contractor's point view, where the site safety is more likely the responsibility of the construction contractor, and where the owners may have different opinions regarding the factors which influence safety performance. The Eastern Province was selected due to the availability of numerous industrial construction activities.

1.6 RESEARCH METHODOLOGY

A flow diagram of the research methodology is presented in Fig.1.2. It involved the following seven steps:

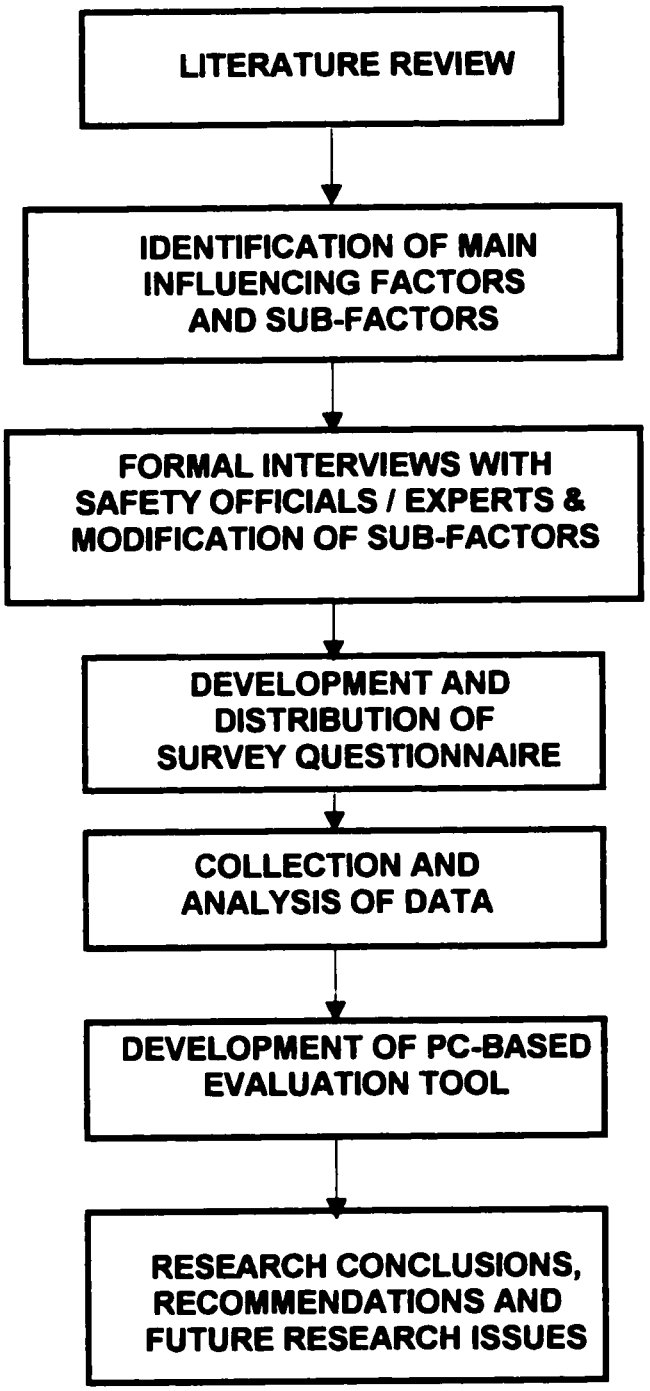


Figure 1.2: Research Methodology

Step 1: Searching literature related to construction safety in general and industrial construction contractors in particular, to identify the significant factors affecting safety performance.

Step 2: Developing a preliminary list of the main factors and their associated sub-factors.

Step-3: Conducting formal interviews with the contractors' key safety personnel and with certified safety experts to assess the factors identified in step 2.

Step 4: Gathering data, through a survey questionnaire, regarding the impact of each factor and sub-factor on the safety performance of the contractor.

Step 5: Collecting and analyzing the survey results.

Step 6: Utilizing features of Microsoft Visual Basic software applications for the development of a PC-based evaluation tool for the measurement of the safety performance of contractors.

Step 7: Providing conclusions, recommendations, and suggestions for future studies.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORY OF SAFETY

Safety may be defined as the conservation of human life and its effectiveness, and the prevention of damage to items as per mission needs. Recorded effort concerning the improvement of safety has been going on for almost two thousand years as is evident from Historia Naturalis written by Pliny, the Elder (A. D. 23-97). For example, in order to stop the inhalation of toxic substances, he called for the wearing of protective masks by workers in question. During the middle ages, George Bauer (1492-1555), father of mineralogy, wrote a 12 volume series on mining and metallurgy. In his writing, he pointed out the problem of mine ventilation and offered several approaches for improving it. Bernadino Ramazzini (1633-1714), father of occupational health and safety, discussed various occupational related diseases and suggested several effective preventive actions (Raouf and Dhillon 1994).

Safety is considered to be a common sense approach to removing agents of injury. Safety, as a concept and practice, has shifted to a complex methodology for the reliable control of injury to human beings and damage to property. However, it does lack a

theoretical base, which may be due to the fact that this concept is still going through the transitional phase just like other fields of sciences of the past (Kuhlmann 1989).

As safety is concerned with reducing accidents and controlling or eliminating hazards at the work place, accident prevention is a significant step toward safety improvement. Nowadays, there is tremendous pressure exerted on companies to improve safety. Major factors responsible for this pressure are economic, social, and regulatory, in the form of government rules. An understanding of accident causes is a prerequisite for safety improvement.

Many attempts have been made over the years to develop a predictive theory of accident causes. Researchers addressing the accident phenomena have come up with conflicting theories. Hale and Surrey (1972) have conducted extensive reviews of the pertinent literature. By and large, most theories proposed are based on two distinct models: Behavioral and situational. Behavior models consider humans as the major, if not the sole, factor responsible for the causes of an accident. On the other hand, the situational models consider the interactions between humans, environment, and situation for studying the accident process.

At present, none of the theories of accident causes are universally accepted. All such theories, regardless of their origin, are basically conceptual in nature and are of limited utility in improving safety performance. Therefore, due to the lack of a theoretical base,

safety is not recognized as science. Improving safety, as usually practiced, involves a critical examination of the worker, the work, and the environment. A continuous improvement of safety performance is one of the desired goals of a successful organization. To be able to embark on a continuous improvement program, it is necessary that safety performance be quantified (Raouf and Dhillon 1994).

In the construction industry, the working environment is constantly changing, sites exist for a relatively short time and the activities and inherent risks change daily. Within a short time of a hazard being identified and dealt with, the work scene has changed, bringing new hazards. There is also a high turnover in the workforce, which means safety awareness is not always as good as it should be (Davies and Tomasin 1990).

The problem of safety performance measurement has existed since the very beginning of organized attempts to control accidents and their consequences. In its most elementary form, measurement has been defined as "the process of assigning numerals to objects according to rules" (Stevens, 1951). As this definition is applied to the safety field, problems concerning what "object" to measure, what "rules" to follow, and what are the benefits of measurement are revealed quickly.

Measurement is the backbone of any scientific approach to problem definition and solution. Without measurement the state of our operations is unknown. Sound measurement is an absolute prerequisite for control, and both are necessary for

prediction. In accident control and prediction valid and reliable measures of safety performance are essential in order to (1) locate and describe problem areas, (2) identify causal relationships, (3) make decisions concerning the optimum allocation of accident prevention resources, (4) evaluate the effectiveness of applied countermeasures, and (5) detect when the system is deteriorating toward unacceptable limits of control (Tarrants, 1980).

2.2 PREVIOUS STUDIES

Numerous authors have addressed various aspects of safety performance measurement in the past years. A book entitled Selected Reading in Safety (Widner, 1973) contains chapters authored by 36 international safety professionals, many of whom have addressed safety measurement in various forms. Charles L. Gilmore (1970) in his book Accident Prevention and Loss Control emphasizes measurement techniques as a means of accomplishing "loss prevention measurement control" His book "offers circumstantial analysis as a replacement for loss occurrence" and his program "employs the existing accepted measurement and statistical techniques of other disciplines and adapts these for loss prevention performance measurement. Books written by Daniel C. Petersen; John V. Grimaldi and Rollin H. Simonds (1975), Safety Management: Accident Cost and Control (3rd edition), and W. G. Johnson (1973), The Management Oversight and Risk Tree (MORT) all address the subject of safety performance measurement in varying levels of detail (Raouf and Dhillon 1994)

Researchers have investigated factors associated with company and project safety success for some time. Much of this research has been descriptive in nature, identifying attributes associated with enhanced construction safety performance. (Fig.2.1) provides a brief overview of key safety research. Significant factors associated with successful safety performance as determined by the research are summarized (Jaselskis, Anderson, and Russell 1996).

Kangari (1995) surveyed the top 100 large U. S. construction firms to study the current attitude toward risk management. The survey results showed that contractors must assume the critically importance safety risk. Assigning it the highest importance rating, construction contract must continuously measure and control their safety performance.

Levens (1974) in his research depicts management as an integrated effort that depends on the interaction of technical, managerial, and cultural subsystems. He highlighted the fact that the methods for effectively managing safety do not differ significantly from those for managing any other function in the organization.

He concluded that If the results of the safety effort do not meet reasonable expectations, then the effort has probably not been given at least as much attention as the traditional areas of management concern: production, quality, schedules, and cost.

Year (1)	Author (s) (2)	Summary of research (3)	Key factors associated with safety success (4)
1976	Levitt and Parker	Related to top-management role in reducing construction accidents.	Company manager's awareness of safety problems. Evaluation of superintendents based on safety performance. Top management pointedly talking about safety when they visited jobs and experienced modification rates (EMR) lower than companies in which this was not mentioned during interviews. Companies that conducted formal safety orientation for all new hires had average EMR lower than companies that had no formal orientation for newly hired workers. Incentives based on lost-time accidents awarded to workers, foremen, and superintendents for accident-free work had no effect on safety, according to research findings. Crews were found to perform work quicker, better and more safely when managers insisted on detailed work planning (including materials, equipment, man power, and safety requirements) prior to the start of the job.
1978	Hinze	Identified safety impact of new worker and turnover rates.	Superintendents whose crews had fewer injuries where those having larger percentage of workers transferring with them from one job to the next. Safety increases when companies retain their employees for more than one year, and there are additional safety benefits when employees are kept for even longer periods of time (five years in this study).
1978	Hinze and Pannullo	Found that increased job control led to better safety performance.	General trends suggested more top-management visits per week lowered the injury index. Injuries tended to be lower in those firms engaging in projects in close proximity to the home office. Safety companies employed the same workers for a longer duration. Safety performance improved when more workers visited the home office regularly.
1978	Hinze and Parker	Investigated superintendent characteristics associated with improved safety performance.	Increased job-related pressure on superintendents led to increase injuries. Superintendents in strong support of job competition and those who only moderate supports of competition. Superintendents who were under pressure to complete the job from the home office had higher injury frequencies.
1979	Hinze and Francine	Investigated supervisor worker relationships and how they affect injury rates.	Supervisors who are more flexible in dealing with subordinate conflicts have better safety records compared to their more rigid counterparts. Safety performance is worse when foremen have full firing authority.
1981	Hinze and Harrison	Identified safety program practices in large companies associated with reduced injury frequency rates.	The corporate safety director hired the field safety representative. Field safety directors trained their subordinate workers. The safety director reported to the president or vice president of the company. New workers received formalized safety orientation. Safety awards were given to workers. Safety awards were given to foremen.
1982	Samelon and Levitt	Identified owner's guidelines for selecting safe contractors.	Owners who involve themselves actively in selecting and monitoring safety performance of contractors have significantly lower accident rates on their construction projects. Several owner strategies were found to have a significant impact on contractor safety: use of short-term worker permits to regulate hazardous operations; stressing safety during the prebid site visit; incorporating detailed job-specific safety requirements in specifications and periodic inspections; maintenance for safety records; setting ambitious goals for contractor safety and rewarding successful achievement of those goals; considering safety as a criteria in presenting contractors for bid lists; providing safety orientation and training materials for contractor's labor and supervision for hazardous operations unique to the particular project; and developing in-house owner construction safety personnel with the expertise to carry out their tasks. Actions such as requiring contractors to delegate safety to on-site personnel, examination of safety at job site meetings, and investigation of accidents were initiated by both safe and average owners. Placement of considerable emphasis on selection of safe contractors by the owner is necessary for fewer monitoring and control actions.

Figure 2.1: Summary of Previous Safety Research
SOURCE: Journal of Construction Engineering and Management / March 1996

Year (1)	Author (s) (2)	Summary of research (3)	Key factors associated with safety success (4)
1988	Hinze and Reboud	Identified appropriate means of achieving or maintaining acceptable safety performance on large projects.	Employed a full-time company safety officer. Strong top-management support for safety. Safety meetings were conducted for supervisors. Supervisor safety performance was monitored. Specific job site safety tours were conducted. Safety issues were included in regular held coordination meetings. Lower incident rates occurred on projects that employed sophisticated scheduling techniques. Better safety results occurred when the owner or owner's representative was included in coordination meetings. Job pressures (particularly those imposed by budgetary constraints) were found to adversely affect safety performance.
1988	Hinze and Figone	Investigated specialty contractors safety as influenced by general contractors on small and medium-sized projects.	Superintendents who felt less project pressure had safer projects. Projects on or ahead of schedule were safer. Companies that emphasis other goals in addition to profits had safer projects than companies only seeking to maximize profit. Companies that negotiated a majority of their prime contracts had safer projects. Several variables related to job coordination affected safety positively; smaller projects; projects with fewer specialty contractors; companies that negotiated a majority of their subcontracts; and companies that use the same specialty contractors. Two variables related to company safety emphasis result in safer projects; companies whose home office monitors project safety, and concern by top management. Two variables related to superintendents' concern for workers result in safer project; superintendents who show concern for workers and superintendent who provide new worker orientation. Two variables related to job cleanliness result in safer projects: good housekeeping, and daily specialty contractor safety inspections.
1988 b	Hinze and Figone	Investigated specialty contractors safety as influenced by general contractors on large projects.	Significant factors correlated with general contractor injury rates; conducting special safety meetings for field supervisors, and employing full-time safety professionals. Significant factors correlated with general contractor safety performance: specialty contractor was involved in project meetings with the owner; general contractor reported directly to the home office rather than the district office; general contractor reviewed specialty contractor safety programs or required them to follow project-wide safety programs: project schedules were prepared by superintendents or site-scheduling department: and general contractor required the specialty contractor to hold "toolbox" safety meetings. Factors that tended to show a relationship to improved general contractor safety performance: the general contractor was not experiencing excessive schedule pressure, general contractors were located farther from their home office: and the general contractor investigated all specialty contractor accidents.
1993	Liska et al.	Identified zero accident techniques.	Safety project/pretask planning included safety goals, safety person/personnel, hiring employees, safety policies and procedures, fire protection program, accountability/responsibility, and safety budget concerns. Safety training and orientation required. Safety incentives provided. Alcohol-and substance-abused program in place. Accident and near-miss investigation conducted. Record keeping and follow-up undertaken. Safety meetings held. Personal protective equipment employed.

Figure 2.1: Summary of Previous Safety Research
SOURCE: Journal of Construction Engineering and Management / March 1996

In his book "The Measurement of Safety Performance", Tarrants expressed the idea that safety performance measurements should indicate the safety level existing within a system or system component in terms of worker behavior and the environmental problems that contribute to the loss-potential conditions.

He believed that the measure should tell us when and where to expect trouble and should provide us with guidelines on what should be done about the problems. He also believed that the evaluation should report continuously on the change in the safety level within the operation and the effectiveness of countermeasures.

Kamal H. Al-Gobali (1994) in his master thesis examined the factors considered in the construction pre-qualification process in Saudi Arabia. He concluded that one of the most important criteria for contractor pre-qualification is Safety Consciousness.

Levitt and Kartam (1990) developed a computer-based system with a limited focus on the owner attempting to evaluate a contractor's safety performance or a firm's safety program. This program has been implemented as simple decision-making tools using an expert system shell running on PC-based computers.

Magyar (1983) described a well designed audit program as that program which: (1) Management can participate in and feel comfortable with; (2) provides an "objective means for evaluation" of the elements which are essential to reliable injury and loss

control; (3) can be easily communicated and understood; (4) provides the basis for the establishment of objectives and the real measurement of real progress; (5) can be used as the base for a safety award or incentive bonus program; and (6) continuously generates observable improvements in the way people work.

In his studies, Hisolp (1991) had shown that hazards on sites can be controlled and accidents can be prevented through the implementation of basic safety practices leading to a sound construction-safety program. The implementation, operation, and monitoring responsibility of the program should be clearly defined at the beginning of construction activities.

2.3 DEFINITION OF MEASUREMENT

Measurement has been defined quite simply by Stevens (1951) as any process that involves "the assignment of numerals to objects or events according to rules" and by N. R. Campbell (1939) as the assignment of numerals to represent properties" Ackoff, Guptas, and Minas (1962) define measurement in terms of its function by stating that "it is a way of obtaining symbols to represent the properties of objects, events, or states, whose symbols have the same relevant relationship to each other as do the things which are represented" (Tarrants 1980).

2.4 THE IMPORTANCE OF SAFETY PERFORMANCE MEASUREMENT IN CONSTRUCTION CONTRACTOR ACCIDENT PREVENTION

In accident prevention, measurement of safety performance is necessary for many reasons (Petersen 1980):

1. To act as a basis for causal factor detection
2. To locate and identify problem areas.
3. To act as a basis for trend comparison.
4. To describe the current safety state of the contractor.
5. To act as a basis for predicting future accident problems.
6. To act as a basis for evaluating accident prevention program effectiveness.
7. To act as a basis for making decisions regarding the allocation of accident prevention resources.
8. To assess accident costs.
9. To establish long-term accident control.
10. To act as a basis for quantifying probable risk of injury or other loss.

2.5 CHARACTERISTICS OF EFFECTIVE MEASURES OF SAFETY PERFORMANCE

It should be recognized that the worthiness of any evaluation technique of safety performance must be appraised in terms of the purpose for which it is constructed. Therefore, it is useful to know what one should look for in a search for improved measures of safety performance.

The following are postulated characteristics of a good measurement technique without regard to their relative importance (Stevense 1958):

2.5.1 Administrative Feasibility

The first characteristic of a good measuring technique is its administrative feasibility. One must be able to construct and use it. It is necessary to give careful consideration to this characteristic. Personnel, time, and financial resources available for use in implementing a measurement system may strongly influence the type of technique that can be used. In some cases an urgent need for immediate results may require that the measuring technique produce practical answers in the shortest period of time. In all cases the return from the investment in a measurement system must far outweigh the various costs involved in implementing and using it.

2.5.2 Constant units of Measure Throughout the Range to be Evaluated

The measurement technique must provide measures that are on an interval scale. In construction, the goal should be not only to know that a contractor's safety performance is improving during the current month or year, but also to know how much it is improving.

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2.5.3 Quantifiable Measurement Criterion Capable of Statistical Analysis

Closely related to the interval scale requirement is the necessity for a measurement criterion to be quantifiable. A qualitative evaluation of safety performance limits statistical inference and opens the way for individual interpretation. The ideal criterion of safety performance should permit statistical inference techniques to be applied since, like

most other measurable quantities dealing with human behavior, safety performance will necessarily be subject to statistical variation.

2.5.4 Sensitivity

A measurement technique should be sensitive enough to detect changes in process and performance levels in order to serve as a criterion for evaluation. Moreover, the frequency of occurrence of a measure must be large enough to permit statistical analyses to be conducted. The ideal measure of safety performance must be sensitive to changes in environmental and behavioral conditions over time.

2.5.5 Reliability

The measurement technique must be reliable; that is, should be capable of repetition with the same results obtained from successive application to the same situations. An ideal measure of safety performance should be reliable to the extent that it provides minimum variability when measuring the same condition.

2.5.6 Stability

Similar to reliability is the need for the criterion to be stable. This involves the maintenance of a given range of values under repeated measures of worker behavior and

environmental conditions. If a process does not change, the measure of its performance level is expected to remain un-changed.

2.5.7 Validity

Of importance is the need for a measure to be valid. This means that it produces information that is representative of what is to be measured. Validating a measure requires the use of an outside criterion that must be carefully chosen to reflect the actual situation.

2.5.8 Error-Free Results

A good measuring technique should yield results that are free from error. The type and magnitude of these errors differ with different techniques.

2.5.9 Efficiency and Comprehensibility

Finally, a good measurement technique should be both efficient and understandable. Efficiency requires that the cost of obtaining and using the technique is consistent with the benefit to be gained. Moreover, it should be easy to obtain with minimum disruption to the normal operations of a contractor. To be understandable suggests that the criterion be understood by those charged with the responsibility for approving and using it.

Without the latter property all others would be of little practical value since the measurement technique would most likely never be used.

The preceding nine characteristics demonstrate that the solution to the problem of finding an effective measurement technique is quite complex. In any case, it is quite unlikely to find all the desired characteristics in a single measurement device, but every effort should be directed towards having a technique with as many of these characteristics as possible.

2.6 MEASURES OF SAFETY PERFORMANCE CURRENTLY USED

A number of safety performance indices are now in use, such as a number of disabling injuries, injury frequency rates, injury severity rates, accident costs, number of deaths, number of first aid cases, recordable occupational illnesses, the ratio of injury severity to injury frequency, and total injury rates. Many of these indices are recommended by the American National Standards Institute (ANSI) for use in measuring safety performance and are described in ANSI's (1993) "Method of Recording and Measuring Work Injury Experience (ANSI Z-16.1).". Injury rates compiled in accordance with this standard are intended to show the relative need for accident prevention activities within an organization, to indicate the seriousness of the accident problem, to measure the effectiveness of safety activities in organizations with comparable hazards, and to evaluate progress in accident prevention within an organization or industry.

The ANSI "Method of Recording and Measuring Work Injury Experience", Z-16.1" suggests that injury experience be measured by means of a disabling injury frequency rate, a disabling injury severity rate, the average days charged per disabling injury and a disabling injury index. ANSI further suggests that the standard injury rates be compiled in accordance with certain rules that are included in the Z-16.1 standard.

The disabling injury frequency rate is based on the total number of death, permanent total, permanent partial, and temporary total disabilities which occur during the period covered by the rate. The rate relates these injuries to hours worked during the period and expresses them in terms of a million-hour unit by use of the following formula (Tarrants 1980):

$$\text{Disabling Injury Frequency Rate (F)} = \frac{\text{Number of disabling injuries} \times 10^6}{\text{Employee hours of exposure}} \qquad (1)$$

The major advantage of the disabling injury frequency rate is that it takes into account differences in quantity of exposure due to varying employee hours of work, either within the plant during successive time periods or among contractors within similar industry classifications. Also, it provides a method for measuring how adequately a safety program is functioning.

The disabling injury severity rate is defined as the number of days lost or charged per million employee hours worked. Days lost include all scheduled charges for all deaths,

permanent total, and permanent partial disabilities, plus the total days of disability from all temporary total injuries which occur during the period covered.

The disabling injury severity rate is expressed as:

$$\text{Disabling Injury Severity Rate (S)} = \frac{\text{Total days charged} \times 10^6}{\text{Employee hours of exposure}} \quad (2)$$

Similar to the injury frequency rate, the major value of the injury severity rate (S) is that it takes into account differences in quantity of exposure over time. It also answers the question "How serious are our injuries?". This rate can be used for making comparisons among different organizations and among various units within an organization.

The average days charged per disabling injury expresses the relationship between the total days charged and the total number of disabling injuries. This index may be computed by dividing the injury severity rate (S) by the injury frequency rate (F) producing an S / F ratio. Or it may be computed directly by simply dividing the total days charged by the total disabling injuries:

$$S / F = \text{Total days charged} / \text{Number of disabling injuries} \quad (3)$$

In effect, this measure reveals whether or not the more severe accidents as well as those with less severity are eliminated.

Another measure for generating occupational safety and health statistics has been developed by the Bureau of Labor Statistics (BLS) under the provisions of the Occupational Safety and Health Act (OSHA). The BLS recordable occupational injury and rate is identified as the incident rate, with a base of 200,000 man-hours exposure (Raouf and Dhillon 1994):

$$\text{Incident Rate} = (N/MH) \times 200{,}000 \quad (4)$$

where:

N = Number of injuries and / or illnesses

MH = Man-hours (Total hours worked by all employees during the reference year).

200,000 = Base for 100 full-time equivalent workers working 40 hours per week, 50 weeks year.

2.7 SHORTCOMINGS OF THE STANDARD INDICES

A close examination of the prevailing methods for evaluating safety performance reveals the following major shortcomings:

2.7.1 The standard methods of evaluation based on injury frequency rates, severity rates, and incidence rates are not sensitive enough to serve as an accurate indicator of safety effectiveness. Only those accidents or illnesses resulting in actual losses are included in the rate computations.

2.7.2 The smaller the work force, the less reliable is the frequency rate, severity rate, or incident rate as an indicator of safety performance, particularly when less than the base numbers of 1 million man-hours (ANSI, Z-16.1) or 200,000 man-hours (BLS-OSHA) are worked during the period.

2.7.3 Lost time accidents, recordable occupational injuries and illnesses, deaths, and other injuries reported according to present criteria are relatively rare events. Small units may go for a long period without a reportable accident or incident under the present systems of measurement.

2.7.4 Under the ANSI, Z-16.1 reporting criteria, a single severe injury or death will drastically alter the severity rate, particularly in small organizations, and thus this index may not accurately reflect overall prevention accomplishment. The problem of chance influences is also present in the frequency and incidence rate measures. In these cases chance determines whether or not an injury is of sufficient severity to be included in the reportable or recordable classifications in the first place.

2.7.5 In the national statistics computed under both systems, comparisons are made among accidents occurring in various types of environments involving non-

parallel hazard categories. For example, the exposure and accident experience of material handlers are lumped together with those of office workers, and similar data for milling machine operators are combined with those of stockroom clerks within rates computed by industry.

2.7.6 The measurement techniques presently in use are only remotely related to the behavioral and environmental changes that prevention programming activities or accident countermeasures are designed to produce. For example, how long does it take for a new safety training program to reflect itself in a reduced frequency rate or incident rate? In most cases we must wait a considerable period of time to allow sufficient exposure to accumulate so that adequate data can be collected for a realistic frequency rate or incident rate appraisal. There may be serious discrepancies between the problems identified by measurement systems used at present and the direct appraisal of the behavioral malfunctions that safety programs and accident countermeasures are designed to influence.

2.7.7 Most present indices of safety and health performance are based on an after-the-fact appraisal of injury-producing or property-damaging accident or work-related illnesses. Some loss must be involved with a certain degree of severity, as defined by the reporting criteria, before an accident appears on a report form. What is needed is a method for examining accidents at the non-injurious state where the potential for loss is involved but where the loss has not yet actually occurred.

2.7.8 Finally, many accidents, particularly the less severe ones, are never reported. Information valuable for analysis and control purposes is thus excluded from the evaluation system used at present. This problem may become especially acute when there is strong competition to show a reduction in the frequency or incidence rate index number as the basis for winning a contest or coming out on top in a safety award program. As the injury decreases in severity, it becomes progressively easier to ignore it or to remove it from the "reportable" or "recordable" category.

These are a few major difficulties associated with the measures of safety performance currently used. They are not presented with the intention of condemning all of the present safety measurement efforts. Frequency and severity rates compiled according to the ANSI Z-16.1 standard have provided a practical and uniform method of measuring disabling injury experience that is almost universally accepted throughout the industry. These measures have not only provided a universal language of safety effectiveness, but have also established a barometer for measuring how accident experience has risen or fallen over time. In addition, they have allowed comparisons to be made among various industries with similar hazards nationwide.

Obviously, these measures have been effective tools or they would not have survived over the years, but like any standard limited to disabling injuries, they do not tell the whole story. One big problem is the accident that escapes detection because it appears

below the fine dividing line established by the ANSI disabling injury or the BLS-OSHA recordable injury or illness definitions. It is important that one should not be influenced into believing that the present measures are really descriptive of the actual level of safety effectiveness within an organization (Raouf and Dhillon 1884).

CHAPTER THREE

FACTORS AFFECTING CONTRACTOR SAFETY PERFORMANCE

An extensive literature review has been conducted to identify the major factors which directly affect the safety performance of construction contractors. In this chapter, the factors identified will be analyzed and ranked. The end results will then be used to develop the proposed PC-based evaluation tool for the measurement of contractor safety performance. The preliminary main and sub-factors already identified are:

3.1 SITE PLANNING AND HOUSEKEEPING

Prior to the start of any contract, an analysis must be made by the contractor to ensure that construction will be conducted in a safe and efficient manner. Similarly, accident prevention is analyzed, both at the planning stage and throughout the contract, so that the contractor may be able to minimize the number of accidents or even eliminate them entirely. Accident prevention is an important factor in the economic success of all contracts. Among other factors that must be considered at the site planning and housekeeping stage are the following (Raouf & Dhillon, 1994):

3.1.1 Initial planning

3.1.2 Site layout

3.1.3 Site illumination

3.1.4 Safe means of access & exit

3.1.5 Storage areas

3.2 WELFARE FACILITIES

The contractor must provide adequate welfare facilities for his employees' usage, prior to starting the construction activities. The following minimum requirements must be met by the contractor in order to prevent construction site accidents (Tarrants, 1980):

3.2.1 Smoking areas

3.2.2 First aid facilities

3.2.3 Drinking water

3.2.4 Toilet and washing facilities

3.2.5 Food facilities

3.2.6 Ambulance

3.2.7 Showers and eyewash fountains

3.3 EMERGENCY / DISASTER PLANNING AND PREPARATION

Effective emergency planning requires that employees be familiar with emergency procedures before a crisis. It is the responsibility of the contractor to ensure that all employees are familiar with the proper response to fire and other serious emergencies.

The potential for emergencies and disasters exists at all construction sites and facilities and their associated costs can be devastating in terms of employee casualties, business interruption, loss of capital investment, etc. These events cannot be avoided but the contractor can reduce their frequency of occurrence and severity of damage with effective preparation and planning. This can be accomplished by developing emergency response plans that address immediate concerns within the contractor's operations. An emergency is an abnormal incident posing a threat to the safety of workers, residents, the environment or property at a facility or site. The emergency can be brought under control using the resources and procedures for emergency response in place for the facility or site, and which include the following (Hislop, 1991):

3.3.1 Emergency plan

3.3.2 Emergency response organization

3.3.3 Emergency drills

3.3.4 Emergency reporting / telephone numbers

3.3.5 Emergency control strategies

3.4 SIGNS, SIGNALS AND BARRICADES

The contractor should establish a system of signaling for all operations in which signals are required to prevent danger. As far as practicable a uniform signaling system must be adopted for all construction s. The code of signals should be posted up at suitable places and also made available in the form of a handbook. In order to avoid danger, the contractor should take adequate steps to ensure that workers are familiar with all signals that they should know (Safety & Health in Building & Civil Engineering Work, International Labor Office, Geneva 1972).

Signals should only be given by reliable, competent persons duly authorized to give signals. No operation should be governed by more than one signal man in charge of the operations; this does not exclude one or more assistant signal man as may be necessary to transmit signals to the person operating the machinery. Also, the signal man should have no other duties when signaling.

The contractor should maintain the following signaling techniques in the construction site (Safety & Health in Building, 1972):

3.4.1 Accident prevention tags.

3.4.2 General signs (danger, caution, & traffic).

3.4.3 Flag men.

3.4.4 Signaling direction (As per ANSI).

3.4.5 Warning garment (Red or Orange).

3.4.6 Crane & hoist signals (As per ANSI).

3.5 HANDLING, STORAGE AND USE OF MATERIALS

The contractor must carefully select his material store yard in order to prevent any accident related to the handling of materials. The travel time to the construction site, adequate aisles & driveways, availability of water supply of sufficient pressure and quantity, and the availability of guards trained in the use of different fire extinguisher equipment are some of the essential factors which the contractor must carefully consider.

The contractor should make sure that all of his stored materials are stacked, racked, blocked, interlocked, or otherwise secured to prevent sliding, falling or collapse. Overall, for the appropriate handling, storage & use of materials, the following important factors must be considered (O'' Brien & Zilly, 1991):

3.5.1 Selection of the storage site

3.5.2 Aisles and driveways

3.5.3 Fence and access gates

3.5.4 Arrangement of materials

3.5.5 Fire protection equipment

3.5.6 Guard service

3.6 WELDING AND CUTTING

Generally, welding and cutting are safe operations if carried out in the correct manner. Where equipment is defective or there is no well-arranged, well-lit, or properly ventilated working place, hazards can arise. The contractor should make sure that all personnel working with welding equipment are well trained, and provided with the necessary personal protective equipment. The need for the operator to take safety precautions and preventive measures during welding operations to ensure that no safety-related incident occurs cannot be overemphasized. The following is a list of the essential considerations which the construction contractor must take into account to ensure safe welding operations (Safety & Health in Building, 1972):

3.6.1 Handling of cylinders

3.6.2 Daily inspection of welding equipment

3.6.3 Personal protective equipment

3.6.4 Adequate ventilation

3.6.5 Welding ground

3.6.6 Fire guard

3.6.7 Health hazards identification

3.7 CONCRETE, CONCRETE FORMS AND SHORING

All equipment and materials used in concrete construction and masonry work shall meet the applicable requirements (ANSI-A-10.9, Safety Requirements for Concrete Construction and Masonry Work) for design, construction, inspection, testing, maintenance, and operations. The contractor should make sure that all the following necessary provisions are made to ensure safe concrete application (Davies & Tomasin, 1990):

3.7.1 Forms and shoring

3.7.2 Personal protective equipment

3.7.3 Work platform / guardrails

3.7.4 Grounded electric vibrator (If any)

3.7.5 Experienced workmanship

3.7.6 Shoring sketches / drawings on site

3.7.7 Adequate shoring for supports

3.8 CRANE & LIFTING EQUIPMENT

Before beginning any crane operation, the supervisor and the operator should complete the pre-operation checklist shown in Figure 3.1. Also, a lift plan showing the essential crane operation requirements must be included, as shown in Figure 3.2. One competent person must be in charged of the lift with the responsibility of explaining in detail, the duties of all involved in the lift before the actual lift commences. The outriggers must be fully extended prior to the lift, and the rubber tiers must be off the ground.

All contractor mobile crane operators require a valid Saudi Arabian Government heavy equipment license. In addition, the cranes shall have a valid crane safety inspection sticker, and manufacturer Safe Working Load (SWL) stickers for all the attached fittings (slings, lifting gear, hooks, chain, rings, etc.,).

The contractor must assign one employee to be the rigger, which requires thorough training. The man assigned must be well acquainted with the capabilities of the crane being used, hand signals, the different functions of the lifting gears, and the various methods of loading.

In general, the following are the essential considerations which the construction contractor must take into account to ensure safe crane operations (Saudi Aramco, 1993):

PRE-LIFT OPERATION CHECKLIST

- **OPERATOR:**

- CURRENT SAUDI ARAB GOVERNMENT CRANE OPERATORS' LICENSE
- CURRENT SAUDI ARAMCO OPERATORS' CERTIFICATE

- **OUTRIGGERS:**

- FULLY EXTENDED
- LEVEL GROUND
- COMPACT SOIL
- HEAVY PAD SUPPORTS
- LOCKING PINS/LOCKS SET
- NO HYDRAULIC LEAKS
- NO DAMAGE
- GOOD CONDITION
- WHEELS OFF THE GROUND

- **OPERATION:**

- CURRENT CRANE SAFETY INSPECTION STICKER
- CLEAR 360^{0} VISIBILITY
- NO SHADES/CURTAINS IN CAB
- LOAD CHARTS IN CAB
- CLEAR VISIBILITY
- WIND, ABOVE 20 m/h (32 km/h), NO GO
- DO NOT OPERATE DURING STORMS AND AT NIGHT
- LIGHTNING, NO GO
- BARRICADE CRANE CAB SWING AREA
- TAG LINES IN USE
- CLEAR OVERHEAD POWER LINES
- CLEAR AREA OF PERSONNEL 1-1/2 x BOOM LENGTHS
- NO LIFTS OVER WORKERS OR CRITICAL PROPERTY
- TRIAL LIFT, FLOAT LOAD ONE METER OFF GROUND TO CHECK BALANCE
- CLEAR VIEW OF SIGNAL MAN (RIGGER)
- DO NOT PULL LOADS WITH CRANE
- LOAD RADIUS INDICATOR
- MAN LIFT WORK PERMIT
- ANTI-TWO BLOCK OPERATIONAL
- LMI (LOAD MOMENT INDICATOR) OPERATIONAL

Figure 3.1: Pre-Lift Operation Checklist
(SOURCE: SAUDI ARAMCO CONSTRUCTION SAFETY MANUAL, 1993)

PRE-LIFT OPERATION CHECKLIST
(Continued)

- **RIGGING:**

- CHECK ALL RIGGING FOR DAMAGE
- CHECK SLING LOAD CAPACITY
- CHECK BLOCK, HOOKS, etc. FOR DAMAGE
- HOOK SAFETY LATCH IN PLACE
- RECORD WEIGHT OF LOAD
- RECORD WEIGHT OF CRANE GEAR, ADD CRANE GEAR WEIGHT TO TOTAL WEIGHT
- LIFT PLAN APPROVED
- USE LOAD WEIGHT MEASURING DEVICE FOR UNKNOWN LOADS

- **TRAVELING:**

- BLOCK SECURED
- TIRES PROPERLY INFLATED AND IN GOOD CONDITION
- BRAKE LIGHTS, SIGNALS, MIRRORS, HORN OPERATIONAL
- ROUTE PLAN CHECKED FOR FIRM GROUND, OVERHEAD AND SIDE RESTRICTIONS
- ESCORT VEHICLES REQUIRED WITH FLASHING BEACON LIGHTS
- SPEED TO BE MAINTAINED FOR SAFE LIMITS (SLOW AS POSSIBLE)

- **PARKING:**

- BOOM AND HOOK BLOCK(S) LOWERED TO TRAVEL POSITION
- APPLY SWING BRAKE AND POSITIVE SWING LOCK
- TIE DOWN HOOK BLOCK(S)
- RETRACT STABILIZERS
- RETRACT OUTRIGGERS
- EXTEND STABILIZERS AND LATCH ONTO FLOAT PADS
- WEIGHT OF CHASSIS OFF THE TIRES
- LET ENGINE IDLE 3-5 MINUTES
  REMOVE ALL FOREIGN MATERIAL FROM CAB(S)
- CLOSE ALL DOORS, WINDOWS, SKYLIGHTS AND COMPARTMENTS
- TURN OFF SWITCHES
- STOP ENGINE

Figure 3.1: Pre-Lift Operation Checklist
(SOURCE: SAUDI ARAMCO CONSTRUCTION SAFETY MANUAL, 1993)

1. Contractor: _____ J.O. No.: _____
2. Crane Inspection Sticker valid: Yes:☐ No:☐ Date of expiry: _____
3. Operator Saudi Aramco certified: Yes:☐ No:☐ 4. Description of load: _____

5. •Type of crane to be used _____
•Boom length (total) _____
•Jib length _____

	Stowed	Erected	N/A	(lbs/kgs)
Jib:	☐	☐	☐	_____
Extension:	☐	☐	☐	_____
Hookblock (Main):	_____	_____	_____	_____
Aux. Boom Head:	_____	☐	☐	_____
Headache Ball:	_____	☐	☐	_____
Slings, Shackles, etc.:	_____	_____	_____	_____
Others:	_____			_____
	_____			_____
Total (Gross Load Weight):				_____

6. • Weight of load _____ lbs/kgs
• Effective weight of jib headache ball _____ lbs/kgs
• Weight of hoist rope below boom tip _____ lbs/kgs
• Weight of other rigging _____ lbs/kgs
Total load weight _____ lbs/kgs
• Effective weight of jib _____ lbs/kgs (see jib chart)
• Weight of load block _____ lbs/kgs
• Weight of spreader bar _____ lbs/kgs

7. Hoisting clearance _____ft/m. 8. Lift quadrant zone _____. 9. Operating radius _____ft/m.
10. Crane capacity at operating radius _____ (**Note:** Do not make lift if total load is greater than crane capacity shown in Item 10. Refer to GI 7.028 for appropriate derating based on type of lift.)
11. Crane capacity for jib configuration: _____ 12. Ground and site conditions: _____
13. Wind speed: _____mph **(Maximum 20 mph)**
14. Work permit required: Yes☐ No:☐
15. Load moment indicator: Yes:☐ No:☐ Type: _____
16. Sketch and supplementary information for crane lift is required to be attached to this plan. (**Note:** The sketch of the crane should include the following rigging information: size of each component; safe working load (SWL) capacity; length of slings; type of component; component diameter; weight of component and sling angles).

Contractor: _____ Date: _____ Crane Operator: _____ Date: _____
Approved: _____ Date: _____ Reviewed by: _____ Date: _____
(Competent Person) (Saudi Aramco Site Representative)
Approved: _____ Date: _____
(Heavy Haul/Rig Move Unit, Transportation Dept., Abqaiq)

Footnote: This form is to be filled out for the following lifts: 1. At all construction sites and operating plants; 2. Associated with offshore and marine sites and operations; 3. Within safety zones of power lines; 4. Involving personnel platforms (as per GI 7.027, 7.028 and 7.030).

Figure 3.2: Lift Plan For Cranes

SOURCE: SAUDI ARAMCO CONSTRUCTION MANUAL

3.8.1 Lift plan on site

3.8.2 Licensed operators

3.8.3 Load radius indicator

3.8.4 Safety latches (Hooks)

3.8.5 Safe working load (SWL)

3.8.6 A well trained rigger

3.8.7 Inspection stickers

3.9 HANDLING CHEMICALS

There are thousands of chemicals in existence and hundreds of new ones are being developed for commercial use every year. While almost all of these chemicals are beneficial in some way, they can be dangerous too. In fact, of the thousands of chemicals in existence, it is difficult to find any that are absolutely harmless.

When dealing with an unfamiliar chemical, it is always wise to assume that it is hazardous. The exposure to hazards associated with a material depends largely on its proper identification, handling, usage, transport, storage and disposal. In addition, material which may be completely harmless in one application may be deadly in other. In

the literature there are many sources of information on the identification, storage, transportation, use, disposal, and hazardous chemical reactions of hundreds of chemicals.

When dealing with a potentially harmful chemicals, precautions should be taken to ensure that employees do not swallow it, inhale it, or allow it to contact their skin. The chemical must not be allowed to accidentally mix with other substances in transportation, storage, or use. It must not be subjected to undue shock, pressure, or heat. When the chemical is no longer needed, it must be safely disposed of or recycled. In general, when dealing with a potentially harmful chemical, the contractor must take carefully the following precautions (De Reamer, 1980):

3.9.1 Proper identification / handling

3.9.2 Adequate storage / usage

3.9.3 Authorized disposal location and procedure

3.9.4 Warning signs (Arabic / English)

3.9.5 Hazard identification system (Health, Fire, Reactivity)

3.9.6 Emergency treatment

3.10 ELECTRICAL EQUIPMENT

The human senses (smell, taste, hearing, etc.) do not provide a warning of an impending electrical hazard. The great majority of electrical accidents result in burns. Fire and explosion from sparks in flammable atmospheres can and do lead to loss of life and serious damage to property. All electrical installations, no matter what voltages are used, should always be treated with great caution.

Distribution of electricity on a construction site is different from a permanent installation. As construction work proceeds, the type of equipment in use changes. From excavation to completion, there is a constant need for convenient means of connecting equipment. This requires a variety of voltages, phases, and current in different places at different times. Load requirements will vary considerably. All temporary electrical systems must conform to the National Electrical Code.

The contractor is responsible for the temporary electric supply system on a construction site and the safety measures associated with the National Electrical Code. The installation work must be carried out by qualified, experienced electricians. Before connecting temporary electrical installations to existing installations, prior approval must be obtained. In order to prevent electrical accidents on construction sites the contractor must evaluate the following items thoroughly (Hammer, 1985):

3.10.1 Temporary installations

3.10.2 Hand tools and lighting

3.10.3 Personal protective equipment

3.10.4 Lockout and tagging

3.10.5 Overhead and underground cables

3.10.6 Initial inspection, tests, or determination

3.10.7 Emergency procedures and first aid

3.10.8 Testing of grounds

3.10.9 Precaution signs

3.11 HANDLING, TRANSPORTATION, DISPOSAL OF HAZARDOUS MATERIAL AND WASTE

When a contractor handles hazardous materials, in the course of performing his obligations under the contract, he shall ensure that the handling of such materials is performed in accordance with currently accepted industry practices for the handling of such material. The contractor shall include in his Loss Prevention Program the procedure for the disposal of solid and liquid wastes. The procedure shall detail specific locations

for the disposal of each type of waste (construction, chemical, sludge, scrap and sewage). It shall also identify the steps to be taken to treat the waste or otherwise prevent it from polluting the ground water or the sea or from becoming a public source of contamination.

The contractor is required to dispose off hazardous waste according to Saudi Arabian Government regulations. In this respect, the contractor must provide proof that the hazardous wastes have been properly disposed of at a licensed hazardous waste disposal facility. Overall, the contractor must give full attention to the following, when dealing with hazardous material & waste (De Reamer, 1980):

3.11.1 Hazard identification plan

3.11.2 Waste management plan

3.11.3 Disposal site

3.11.4 Disposal documents

3.12 PERSONAL PROTECTIVE EQUIPMENT

When a hazardous situation is recognized, steps should be taken to eliminate the hazard by engineering controls. Should it prove impractical to eliminate the hazard, then personal protective equipment must be used that meets the requirements of ANSI or equivalent standards. When it has been decided that Personal Protective Equipment

(PPE) is required, steps must be taken to select the proper type of equipment and ensure that the supervisor instructs his employees in the use and care of that equipment, in accordance with the instructions provided by the manufacturer, as shown in Figure 3.3.

An interviewer has mentioned that most construction employees seem to think that a hard hat is all the personal protection they need on the job site. However, underestimating the potential/inherent dangers they are seriously misunderstanding (Reference 12). This misconception has led to many serious injuries and fatalities (Loss Prevention Statistics 1997). Each year numerous construction workers are killed and even more are seriously injured because they failed to take appropriate protective measures.

These fatalities could have been prevented, or the seriousness of the injuries minimized, if those involved had used appropriate PPE. All workers must wear basic personal protection on the job site. This protection may include (Saudi Aramco, 1993):

3.12.1 Head protection

3.12.2 Eye and face protection

3.12.3 Hand protection

3.12.4 Foot protection

3.12.5 Hearing protection

KEY TO PERSONAL PROTECTIVE EQUIPMENT

The table below is a list of basic personal protective equipment. Many job classifications may require additional personal protective equipment depending on the work location, type of job, local hazards, conditions, etc. The Loss Prevention or Industrial Hygiene office in your area should be contacted for further details.

Typical Job Classifications	Basic Personal Protective Equipment To Be Worn (see key below)
Abrasive blast cleaner	Refer to blasting specification
Boiler maker	1, 8, 9, 10D, 15B
Carpenter	1, 8, 9, 10C, 15A
Electrician	1, 2, 8, 9, 10B, 15A, or B
Iron worker-structural	1, 8, 9, 10D, 12 / 13, & 14 A / B, 15A
Lineman	1, 8, 9, 10C, 12 / 13, & 14 A / B, 15A
Mason	1, 8, 9, 10C / A, 15A
Material Control Man	1, 8, 9, 10C, 15A
Mechanic / Machinist	1, 8, 9, 10C / A, 15A
Painter	See Coating Section
Pipe fitter	1, 8, 9, 10C / D, 15A
Plumber	1, 8, 9, 10C, 15A
Rigger	1, 8, 9, 10C, 15A
Roof worker	1, 8, 9, 10C, 12 / 13 & 14 A / B, 15A
Scaffold erector	1, 8, 9, 10C, 13 & 14 A / B, 15A
Sheet metal worker	1, 8, 9, 10C / D, 15A
Welder	1A & B, 4, 8, 9, 10D / E, 15 B

Key To Personal Protective Equipment

1. Safety glasses with side shields (1A=Clear, 1B=Shaded)
2. Face shield
3. Goggles, safety impact (3A=Clear, 3B=Shaded)
4. Welding hood and skull guard (Lens shaded to suit work)
5. Respirable air fed hood with filter
6. Respirator, chemical cartridge
7. Respirator dust
8. Safety hat helmet
9. Safety foot wear (9A=shoes, 9B=boots)
10. Gloves (10A=Rubber coated, 10B=Rubber molded, 10C= General purposes, 10D = leather, 10E = Heat resistant)
11. Ear protection (11A = Ear plugs, 11B = Ear muffs)
12. Standard safety belt
13. Full body harness
14. Lanyard 1.82m (6FD). (14A = Standard, 14B = Shock Absorbing)
15. One piece coverall (15A = Standard, 15B = Fire Resistant)

Note: All personal protective equipment shall meet ANSI/OSHA or their equivalent requirements. Any worker 1.82 m above ground without the protection of a guard rail system, or in a confined space, shall wear a full body harness and standard lanyard. Respiratory protection shall be used anytime workers could inhale air contaminants exceeding permissible exposure limits (PEL), and when an oxygen deficient atmosphere could be encountered. Breathing quality air shall be supplied to the worker through the use of an air fed hood or self-contained breathing apparatus.

Figure 3.3: Key To Personal Protective Equipment

(SOURCE: SAUDI ARAMCO CONSTRUCTION SAFETY MANUAL, 1993)

3.12.6 Full restraining / arresting devices

3.12.7 Breathing apparatus

3.13 FIRE PREVENTION

Prior to construction start-up, the contractor must take into account the potential hazards that can be encountered on the construction site by making provisions for the following: protection of machinery and equipment; storage of flammable and combustible materials; housekeeping; staff training; and end-of-shift checks.

Each contractor has a contractual obligation to provide and maintain adequate, easily accessible fire extinguishers on the job site. There are three types of fire extinguishers which are normally found in construction sites: water, carbon dioxide and dry chemical types, as shown in Figure 3.4. Contractor personnel should be aware of the fire fighting equipment available on site and be familiar with its use. To maintain an efficient Fire Prevention Program, the contractor must consider the following thoroughly (Planer, 1984):

3.13.1 Adequate fire extinguishers at all locations

3.13.2 Control of ignition sources

3.13.3 Storage of flammable liquids

	Water Type Stored Pressure	Carbon Dioxide $C0_2$ Stored Pressure	Sodium or Potassium Bicarbonate Cartridge Operated	Multi-Purpose ABC Cartridge Operated
CLASS A FIRES - Ordinary Combustibles Wood, paper, trash	Yes	No	No	Yes
CLASS B FIRES - Flammable Liquids and Gases Gasoline, oil, paints, grease, etc.	No	Yes	Yes	Yes
CLASS C FIRES - Energized electrical equipment	No	Yes	Yes	Yes
METHOD OF OPERATION	**Pull pin, unclip nozzle, squeeze handle and direct at base of fire**	**Pull pin, unclip discharge horn, squeeze handle and blanket fire with CO_2**	**Unclip hose to break seal and strike actuator; squeeze nozzle and direct at base of flames, sweeping from side to side.**	**Unclip hose to break seal and strike actuator; squeeze nozzle and direct at base of flames, sweeping from side to side.**
RANGE	30'-40'	3'-8'	5'-20'	5'20'
STOCK NUMBER	21-104-550	21-102-223	21-102-820	21-102-775

Maintenance:

Maintenance should comprise of a monthly check by proponent organization - Check extinguisher is in correct location, access is unobstructed and extinguisher is clearly visible. Check contents gauges, where fitted, indicate extinguisher is serviceable. Check for signs of leakage, corrosion, or physical damage. Check seals are unbroken and up to date inspection tag is fitted. If in doubt, contact your local fire control unit.

Figure 3.4: Types of Fire Extinguishers

(SOURCE: SAUDI ARAMCO CONSTRUCTION MANUAL)

3.13.4 Storage of combustible materials

3.13.5 Fire extinguisher training / drills

3.13.6 Fire watches

3.13.7 Posting of emergency telephone numbers

3.13.8 Regular maintenance of fire extinguishers

3.14 TRANSPORTATION

The contractor must employ only qualified personnel as drivers of motor vehicles, and provide them with regular refresher driving courses and training. It is a Saudi Arabian Government law that each person driving a motor vehicle must possess a valid Saudi Arabian Government driver's license. It is the responsibility of the driver to ensure that his vehicle is safe to operate. In order to prevent serious injuries and fatalities resulting from motor vehicle accidents, the contractor must consider the following (Hammer, 1985):

3.14.1 Vehicle condition

3.14.2 Passenger seating & seat belts

3.14.3 Motor vehicle regulations (Saudi Arab Government)

3.14.4 First aid equipment

3.14.5 Fire extinguishers

3.15 EXCAVATION, TRENCHING & SHORING

Accidents due to cave-in can occur in excavations which are not shored or otherwise supported. Smooth rock that looks solid from a cursory inspection can collapse without warning. The sides of an excavation may need to be suitably shored, benched or sloped back to a safe angle of repose, depth, and soil composition. Other types of excavation accidents are caused by contact with underground pipes and cables, by falls of equipment and persons, by persons being struck by excavation equipment, and from poisonous gases or emissions.

Workers must be protected from cave-ins, from materials that could fall or roll into the excavation onto the workers or from collapse of adjacent structures. This can be achieved by including supports, sloping and benching, shields and other means of protecting workers. In order to begin excavation work with minimum risk to men, equipment and surroundings and to enable the work to proceed without interruption, provisions must be made before the job starts (Hammer, 1985):

3.15.1 Shoring / trench boxes

3.15.2 Sloping / benching

3.15.3 Excavation plans

3.15.4 Work permits

3.15.5 Access & egress routes

3.15.6 Hazardous atmospheres and materials

3.15.7 Emergency rescue equipment

3.16 SCAFFOLDING & LADDERS

The contractor has a legal and contractual responsibility to ensure that each place at which his men work is safe and that it remains safe as long as men work there. Where work can not safely be done on the ground or from part of a building or permanent structure, scaffolds, ladders, or other means of support shall be provided and properly maintained.

The scaffold structures shall be erected with metal components approved per ANSI requirements or equivalent. Scaffolds shall be stored to prevent damage and to permit easy access for use. All fittings (couplers, base plate, screw jacks, planks, clamps, etc.) shall be of a metal type approved to ANSI requirements. They shall be examined regularly and care must be taken to ensure that moving parts are sound and well lubricated and that threads are not stripped. Overall, the contractor must maintain the following items in perfect conditions in order to avoid serious accidents due to improper or miss used scaffolds (Saudi Aramco, 1993):

3.16.1 Check condition of frame members

3.16.2 Supply base and sole plates

3.16.3 Check plumb and level

3.16.4 Provide planking

3.16.5 Enhance experienced workmanship

3.16.6 Provide scaffold access

3.16.7 Maintain erection plans

3.16.8 Insure proper loading

3.16.9 Check guardrails & toeboards

3.16.10 Perform periodic inspection

3.16.11 Maintain adequate foundations

3.16.12 Use cross bracing

3.16.13 Insure secured ties

3.17 HAND AND POWER TOOLS

Hand tools are those tools for which the hand provides the principle force, e.g., picks, shovels, axes, crowbars, wrenches, saws, hammers, screwdrivers, etc. It is the contractor's duty to ensure that his workmen are properly instructed in the selection and use of the correct tool for the job. Tools constructed of good materials should always be

used. Poor quality tools increase the risk of accidents and also reduce the efficiency of work.

Power tools, however, allow many jobs to be carried out more efficiently and with greater speed and accuracy. The correct use of power tools can only be achieved by the proper training of workmen, by proper maintenance, and by adequate site supervision. Many accidents have occurred because unskilled and untrained laborers have been allowed to operate power tools in an incorrect manner. Therefore, to reduce hand and power tools accidents, the contractor must consider the following seriously (Raouf & Dhillow, 1994):

3.17.1 Overall condition / daily Inspection

3.17.2 Damaged hand tools

3.17.3 Individual tools precautions

3.17.4 Personal protective equipment

3.17.5 Selection

3.17.6 Training

3.17.7 Manufacturer specifications

3.18 MECHANICAL EQUIPMENT

The widespread use of mechanical equipment in the construction industry improves the quality and efficiency of the work but it can lead to situations which are potentially hazardous. The only safe way of using mechanical equipment is to have properly trained operators, running equipment that is well maintained and designed for the work for which it is being used.

It is the responsibility of the contractor to train and test all equipment operators and issue them with written authorization specifying the equipment which they are competent to operate. In addition, the operators of mobile heavy equipment must be in possession of a Saudi Arabian Government license for that particular class of machinery. Generally, the contractor must consider the following (Tarrants, 1980):

3.18.1 Qualified operators

3.18.2 Licensing requirements

3.18.3 Machinery guards

3.18.4 Regular inspections

3.18.5 Strict maintenance schedules

3.18.6 Personnel protective equipment

3.18.7 Adequate relief valves

3.19 IONIZING RADIATION

Ionizing industrial radiation, such as x-rays generated by equipment or gamma rays emitted spontaneously by radioactive materials, are widely used in industry for non-destructive testing, e. g., testing of welds in pipes and pressure vessels, without damaging the material. The material tested must not retain any radioactivity when testing has been completed.

For all practical purposes, the radiation produced by x-ray equipment or emitted by radioactive sources are the same. X-rays and gamma rays both have properties which should be understood. Even though they penetrate the body, they cannot be perceived by any of our five senses. They can be absorbed and scattered by matter; they travel in straight lines at the speed of light; they ionize gases; they affect photographic emulsions; and by far the most important, they can be harmful to the living cells of the body.

It is the full responsibility of the contractor to make sure that all workers involved with industrial radiation are well trained and knowledgeable of the work activities. In order to control human exposure to industrial radiation, the contractor must consider the following seriously (Safety & Health in Building, 1972):

3.19.1 Health hazard identification

3.19.2 Protection against radiation (Distance, Time & Shielding)

3.19.3 Adequate training

3.19.4 Exposure limits

3.19.5 Safe handling

3.19.6 Intensive inspection each shift

3.19.7 Shipping & transportation

3.19.8 Storage areas

3.20 MANAGEMENT INVOLVEMENT

A critical task in developing a viable safety program is to define management's policy. Most programs fail due to the lack of sincere interest by top management. If top-level management is not genuinely interested in safety procedures, it is most likely that no one else in the company will be. The policy established should contain only what can be supported by intentions and available resources, as shown in Figure 3.5. The safety program goals, shown in Figure 3.6, should be achievable, but demanding and measurable, so that achievements can be monitored and measured (O'Brien and Zilly, 1991).

To ensure top management involvement, the contractor must consider the following (O'Brient and Zilly, 1991):

ANY COMPANY CONSTRUCTION, INC.

SAFETY POLICY STATEMENT

It is the policy of the management of ANY CONSTRUCTION COMPANY, INC. that all reachable and practical efforts will be made to provide a safe and healthful place of employment for all employees and to do everything reasonable to protect equipment and other properties from accidental losses.

Accidents interfere with the orderly progress of our work and are indications of an inefficient operation. All necessary action will be taken to prevent losses at the lowest operating level consistent with the operating policy of the firm.

It is the intent of this firm to comply with all local, state, and federal safety standards, codes, and regulations. We expect every employee of the firm to perform their job in a safe manner and in accordance with the procedures outlined in the company safety program.

SIGNED: _____

TITLE: _____

FIRM: _____ DATE: _____

Figure 3.5: Sample Safety Policy Statement

SOURCE: James J. O'Brien and Robert G. Zilly (1991), "Contractor's Management Handbook, Second Edition". McGraw-Hill, Inc., New York

SAFETY PROGRAM GOALS

It is the policy of the firm that both long-and short -term goals be set to be accomplished within our safety program. The goals established will be based on the need to improve safety performance and to reduce the operating expenses associated with accidents.

At the beginning of each year major objectives to be accomplished for the year will be established. Short-term or specific goals will be established as the need arises. Goals will be documented on the SAFETY PROGRAM GOALS form and filed for use on all projects.

Recognition of the problem and the establishment of a goal to overcome the problem are primary steps; determining the solution to the problem is the challenge. The goals must be realistic and obtainable to make the plan workable.

Figure 3.6: Sample Statement of Safety Program Goals

SOURCE: James J. O'Brien and Robert G. Zilly (1991), "Contractor's Management Handbook, Second Edition". McGraw-Hill, Inc., New York

3.20.1 Initiate and administer a Safety Policy of Company

3.20.2 Be familiar with and adhere to the requirements of workmen's regulations

3.20.3 Ensure that there are qualified and well trained supervisors and other employees

3.20.4 Consider safety at tendering, planning and contract

3.20.5 Instate and insure adherence to a loss prevention program

3.20.6 Emphasize accountability of supervisor

3.20.7 Set a good personal example

3.20.8 Prepare a hazard identification plan

3.20.9 Prepare emergency evacuation procedures

3.20.10 Communicate and share safety program activities, experience and results with others

3.20.11 Create awareness / provide motivation (i.e. group meetings, literature, film show, posters, bulletin boards, and incentives)

CHAPTER FOUR

THE DEVELOPMENT OF A COMPUTERIZED TOOL

4.1 INTRODUCTION

This chapter addresses the procedures that were followed to achieve the objectives set for this research study, i.e. to develop a PC-based evaluation tool that incorporates all the factors identified as having an effect on safety performance. It includes the formal interviews, a description of the questionnaire which contractors were asked to complete, the analysis and scoring data, and the sample survey. The integration of these steps has given the end product "A PC based evaluation tool for measuring the safety performance of contractors".

The development of the tool passed through several stages until it came to its final form. At each stage, a new concept or idea was generated. Most of these were made while conducting the formal interviews with the contractor safety officials and with certified safety experts. The research has focused on the industrial construction contractor in the Eastern Province of the Kingdom of Saudi Arabia.

4.2 FORMAL INTERVIEWS WITH SAFETY EXPERTS:

Formal interviews with the key safety personnel of contractors and with certified safety experts were conducted to assess what were identified as the 20 main factors and 139 sub-factors, listed in Chapter 3. As a result, a modified list of the 20 main factors and 85 sub-factors was developed. This modification was achieved by grouping some similar sub-factors in order to have quantitative sub-factors that can be accurately evaluated. Additional sub-factors were also added to the subject list, as shown in Table 4.1. In addition, evaluation criteria for all the sub-factors (which could be incorporated into the PC-based evaluation tool, as shown in Table 4.2) were developed during the formal interviews.

4.3 DESCRIPTION OF THE QUESTIONNAIRE

In order to collect the data required from the industrial construction contractors to build the PC-based tool, a questionnaire was developed. This questionnaire includes the 20 items identified as main influencing factors, as presented in Figure 4.1. The purpose of the questionnaire is to reveal those factors which affect safety performance level of the contractor and the importance (or weights) of these factors. See Appendix (A) for a sample questionnaire.

Table 4.1: Initial vs. Modified Main and Sub-Factors

	INITIAL MAIN & SUB-FACTORS	MODIFIED MAIN & SUBFACTORS	REASONS
1.0	Site planning and housekeeping	Site planning and housekeeping	Initial Planning is considered part of Site Layout, and storage areas are considered part of the fifth Main Factor "Material Handling, Storage and Use".
1.1	Initial planning	Site layout	
1.2	Site layout	Site illumination	
1.3	Site illumination	Safe means of access & exit	
1.4	Safe means of access & exit		
1.5	Storage areas		
2.0	Welfare facilities	Welfare facilities	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.
2.1	Smoking areas	First aid facilities	
2.2	First Aid facilities	Food & drinking water facilities	
2.3	Drinking water	Ambulance	
2.4	Toilet & washing facilities	Showers & eyewash fountains	
2.5	Food facilities	Smoking area / Toilet and washing facilities	
2.6	Ambulance		
2.7	Showers & eyewash fountains		
3.0	Emergency / disaster planning and preparation	Emergency / disaster planning and preparation	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.
3.1	Emergency planning	Emergency response organization / procedures	
3.2	Emergency response organization	Emergency response training / drills	
3.3	Emergency drills		
3.4	Emergency reporting / telephone number		
3.5	Emergency control strategies		
4.0	Signs, signals & barricades	Signs, signals & barricades	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.
4.1	Accident prevention tags	General signs (danger, caution, traffic, and Accident prevention tags).	
4.2	General signs (danger, caution and traffic)	Flag men / Warning garment (red / orange)	
4.3	Flag men	Signaling direction (as per ANSI)	
4.4	Signaling direction (per ANSI)	Crane & hoist signals (as per ANSI)	
4.5	Warning garment (red / orange)		
4.6	Crane & hoist signals (per ANSI)		
5.0	Materials handling, storage and use	Materials handling, storage and use	One sub-factor "selection of the site" was deleted, as it was considered in the first Main factor.
5.1	Selection of the site	Aisles and driveways	
5.2	Aisles and driveways	Fence and access gates	
5.3	Fence and access gates	Arrangement of materials	
5.4	Arrangement of materials	Fire protection equipment	
5.5	Fire protection equipment		
5.6	Guard service		

Table 4.1: Initial vs. Modified Main and Sub-Factors
(Continued)

	INITIAL MAIN & SUB-FACTORS	MODIFIED MAIN & SUBFACTORS	REASONS
6.0 6.1 6.2 6.3 6.4 6.5 6.6 6.7	Welding and cutting Handling of cylinders Daily inspection of welding equipment Personal protective equipment Adequate ventilation Welding ground Fire guard Health hazards identification	Welding and cutting Handling of cylinders Daily inspection of equipment Adequate ventilation Grounding / Fire guard Personal protective equipment	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated., and one sub-factor was considered as one sub-factor of the twentieth Main Factor "Management Involvement".
7.0 7.1 7.2 7.3 7.4 7.5 7.6 7.7	Concrete & concrete formworks Form and shoring Personal protective equipment Work platform / guardrails Grounded electric vibrator Experienced workmanship Shoring sketches / Drawings on site Adequate shoring for supports	Concrete & concrete formworks Work platform / guardrails Grounded electric vibrator Experienced workmanship Shoring sketches / Drawings on site Forms / adequate shoring for supports	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated, and one sub-factor was canceled as it was considered as a Main Factor "Personal Protective Equipment".
8.0 8.1 8.2 8.3 8.4 8.5 8.6 8.7	Crane and lifting equipment Lift plan on site Licensed operators Load radius indicator safety latches (Hooks) Safe working load (SWL) A well trained rigger Inspection stickers	Crane and lifting equipment Lift plan on site Licensed operators Safe working load indicator / inspection sticker Safety latches (Hooks) Rigger training	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.
9.0 9.1 9.2 9.3 9.4 9.5 9.6	Chemical handling Proper identification / handling Adequate storage / usage Authorized disposal Warning signs (Arabic/ English) Hazard identification system (health, fire, reactivity) Emergency treatment	Chemical handling Proper identification / warning signs (Arabic/ English) Adequate storage / usage Emergency treatment	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.
10.0 10.1 10.2 10.3 10.4 10.5 10.6 10.7 10.8 10.9	Electrical equipment Temporary installation Hand tools & lighting Personal protective equipment Lockout & tagging Overhead & underground cables Initial inspection, tests, or Determination Emergency procedures / first aid Testing of grounds Precaution signs	Electrical equipment Temporary installation precaution Lockout & tagging /warning signs Initial inspection, tests Testing of grounds	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.

Table 4.1: Initial vs. Modified Main and Sub-Factors
(Continued)

	INITIAL MAIN & SUB-FACTORS	MODIFIED MAIN & SUBFACTORS	REASONS
11.0 11.1 11.2 11.3 11.4	Handling, transportation, disposal of hazardous material and waste Hazard identification plan Waste management plan Disposal sites Disposal documents	Handling, transportation, disposal of hazardous material and waste Hazard identification plan Waste management plan Disposal sites / Disposal documents	Two sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.
12.0 12.1 12.2 12.3 12.4 12.5 12.6 12.7	Personal protective equipment Head protection Eye & face protection Hand protection Foot protection Hearing protection Fall restraining / arresting devices Breathing apparatus	Personal protective equipment Head/eye/face/hand/foot, and hearing protection Fall restraining / arresting devices Breathing apparatus	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.
13.0 13.1 13.2 13.3 13.4 13.5 13.6 13.7 13.8	Fire protection Adequate fire extinguishers / locations Control of ignition sources Storage of flammable liquids Storage of combustible materials Fire extinguisher training / drills Fire watches Emergency telephone numbers posted Fire extinguishers regular maintenance	Fire protection Adequate fire extinguishers / locations Control of ignition sources / fire watches Storage of flammable liquids / combustible materials Fire extinguisher training / drills Fire extinguishers regular maintenance	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.
14.0 14.1 14.2 14.3 14.4 14.5	Transportation Vehicle condition Passenger seating & seat belts Motor vehicle regulations (Saudi Arabian Government) First aid equipment Fire extinguishers	Transportation Vehicle condition / regular maintenance Passenger seating /seat belts enforcement Motor vehicle regulations (Saudi Arab Government) First aid equipment / fire extinguishers Driver training	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated. A new sub-factor was added.
15.0 15.1 15.2 15.3 15.4 15.5 15.6 15.7	Excavation, trenching & shoring Shoring / trenching boxes Sloping / benching Excavation plan Work permit Access & Egress Hazardous atmospheres & materials Emergency rescue equipment	Excavation, trenching & shoring Cave-in protection (shoring / trenching / sloping/benching) Excavation plan on site Access, exits and walkways	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.

Table 4.1: Initial vs. Modified Main and Sub-Factors
(Continued)

	INITIAL MAIN & SUB-FACTORS	MODIFIED MAIN & SUBFACTORS	REASONS
16.0 16.1 16.2 16.3 16.4 16.5 16.6 16.7 16.8 16.9 16.10 16.11 16.12 16.13	Scaffolding and ladders Condition of frame members Base & sole plates Plumb & level Planking Experienced workmanship Scaffold access Erection plans Proper loading Guardrails & toeboards Periodic inspection Foundations Cross bracing Secured ties	Scaffolding and ladders Adequate components and fittings (frame members / base & sole plates / plumb & level / planking) Experienced workmanship Scaffold access and proper loading Adequate scaffolding stability (guardrails / toeboards / secured ties / foundations and cross bracing)	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.
17.0 17.1 17.2 17.3 17.4 17.5 17.6 17.7	Hand and power tools Overall condition/daily inspect. Damaged hand tools Individual tools precautions Personal protective equipment Selection Training Manufacturer specifications	Hand and power tools Overall condition / daily inspection Individual tool precautions Selection / training	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated. Repeated sub-factors were deleted.
18.0 18.1 18.2 18.3 18.4 18.5 18.6 18.7	Mechanical equipment Qualified operators Licensing requirements Machinery guards Regular inspections Strict maintenance schedules Personal protective equipment Relief valves	Mechanical equipment Qualified and certified operators Machinery guards and safety protection devices Regular inspections and strict maintenance schedules	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated. Repeated sub-factors were deleted.
19.0 19.1 19.2 19.3 19.4 19.5 19.6 19.7 19.8	Ionization radiation Health hazard identification Protection against radiation (distance, time and shielding) Adequate training Exposure limits Safe handling Intensive inspection each shift Shipping and transportation Storage areas	Ionization radiation Health hazard identification Protection against radiation (distance, time and shielding) Adequate training and Safe handling Intensive inspection each shift Shipping / transportation / storage areas	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated.

Table 4.1: Initial vs. Modified Main and Sub-Factors
(Continued)

	INITIAL MAIN & SUB-FACTORS	MODIFIED MAIN & SUBFACTORS	REASONS
20.0	Management involvement	Management involvement	Similar sub-factors were grouped to form quantitative sub-factors that can be accurately evaluated. A new sub-factor was added to the list.
20.1	Initiate & administer a company's safety policy	Initiate & administer a company's safety policy	
20.2	Know and adhere to the requirements of workmen's regulations	Know and adhere to the requirements of workmen's regulations	
20.3	Ensure qualified and well trained supervisors and other employees	Ensure qualified and well trained supervisors	
20.4	Consider safety at tendering, planning and contract	Consider safety at tendering, planning and contract	
20.5	Instate and insure adherence to loss prevention program	Instate and adhere to loss prevention program	
20.6	Accountability of supervisor	Fix accountability of safety	
20.7	Set a personal example	Set a personal example	
20.8	Prepare hazard identification plan	Prepare hazard identification plan	
20.9	Prepare emergency evacuation procedures	Prepare emergency evacuation procedures	
20.10	Communicate and share safety program activities, experience and results with others	Communicate and share safety program activities, experience and results with others	
		Safety motivation (group meeting, literature, film showings, posters, bulletin boards and incentives)	

Table 4.2: Evaluation Criteria Based On Formal Interviews

CRITERIA	DESCRIPTION
Poor (Score = 1)	Sub-factor is missing or not adequate, not well maintained, not properly supplied, not effective for total work force. Also, there are no signs or attempts for improvement.
Fair (Score = 5)	Sub-factor is partially adequate or partially maintained. Some attempts for improvement are being made.
Good (Score = 7)	Sub-factor is adequate and well maintained, it meets minimum requirements of the construction industry standards with continuous efforts for improvement.
Excellent (Score = 10)	In addition to "Good" the sub-factor meets full requirements of the International Standards, Codes, and Government Regulations.

FACTORS AFFECTING THE CONTRACTOR SAFETY PERFORMANCE

1. SITE PLANNING AND HOUSEKEEPING
2. WELFARE FACILITIES
3. EMERGENCY/DISASTER PLANNING AND PREPARATION
4. SIGNS, SIGNALS AND BARRICADES
5. MATERIALS HANDLING, STORAGE AND USE
6. WELDING AND CUTTING
7. CONCRETE AND CONCRETE FORMWORKS
8. CRANE AND LIFTING EQUIPMENT
9. CHEMICAL HANDLING
10. ELECTRICAL EQUIPMENT
11. HANDLING, TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIAL AND WASTE
12. PERSONAL PROTECTIVE EQUIPMENT
13. FIRE PREVENTION
14. TRANSPORTATION
15. EXCAVATION, TRENCHING AND SHORING
16. SCAFFOLDING AND LADDERS
17. HAND AND POWER TOOLS
18. MECHANICAL EQUIPMENT
19. IONIZING RADIATION
20. MANAGEMENT INVOLVEMENT

Figure 4.1: Main Influencing Factors Listed in The Survey Questionnaire

The following resources were used to design the questionnaire:

- The check-off sheets for the construction industry, developed by the Occupational Safety and Health Administration, (Davies and Tomasin).
- The safety effort survey / rating form, shown in Figure 4.2, developed by the National Occupational Safety Association (Tarrants 1980).
- The loss prevention self-appraisal form for managers, as shown in Figure 4.3, (Partlow 1974).
- The master development and evaluation grid, shown in Figure 4.4, (Peterson 1980).
- The sample measurement technique, Appendix-B, (Diekemper and Spartz 1970).
- A book entitled "The design and understanding of survey questionnaires", (Belson 1981).
- A book entitled "Questionnaires: Design and Use", (Berdie and Anderson 1974).

The first part of the questionnaire contains general information and this includes the type of construction activities typically involved with, and the type of the safety program quality monitoring system typically used by the contractors surveyed. The second part of the questionnaire contains 20 main factors and 85 sub-factors relevant to the safety performance of contractors, as shown in Appendix (A).

	Max	Actual	Action
1.00 PREMISES AND HOUSKEEPING			
1.10 PREMISES			
1.11 Buildings and Doors-Clean and in good state of repair	40		
1.12 Good lighting state of repair	20		
1.13 Ventilation	30		
1.20 HOUSEKEEPING			
1.21 Aisles and storage demarcated	30		
1.22 Good sacking and storage practices	50		
1.23 Factory and yard-clear of material	60		
1.24 Scrap and refuse bins-removal and disposal	30		
1.25 Color coding- machinists, pipe-lines-other	40		
SECTION RATING	300	%	
2.00 ELECTRICAL, MECHANICAL & PERSONAL SAFEGUARDING			
2.10 MECHANICAL EQUIPMENT			
2.11 Machine guarding	150		
2.12 Lock-out system and usage	40		
2.13 Labeling of shut-off valves, switches, isolators.	30		
2.14 Ladders, stairs, walkways.	40		
2.15 Lifting gear and records	40		
2.16 Compressed gases, pressure vessels and records	30		
2.20 ELECTRICAL EQUIPMENT			
2.21 Portable electrical equipment-monthly check and records	40		
2.22 Earth leakage relays-permanent and portable	30		
2.23 General electrical installation	50		
2.30 HAND TOOLS-All types: condition, storage and use	50		
2.40 PROTECTIVE EQUIPMENT			
2.41 Head protectors	20		
2.42 Eye protectors	20		
2.43 Foot protectors	20		
2.44 Protective clothing, including hand protectors	20		
2.45 Respiratory equipment	20		
2.46 Maintenance	20		
SECTION RATING	620	%	

	Max	Actual	Action
3.00 FIRE PROTECTION AND PREVENTION			
3.10 Correct extinguishers	40		
3.20 Extinguishers accessible	20		
3.30 Locations marked	20		
3.40 Maintenance of equip.	30		
3.50 Storage of flammable	30		
3.60 Signs to exits/alarm syst.	30		
3.70 Fire fighting drill	80		
SECTION RATING	250	%	
4.00 ACCIDENT RECORDING AND INVESTIGATION			
4.10 RECORDS			
4.11 Adequate accident record	30		
4.12 Internal accident report form signed by supervisor	30		
4.13 Adequate accident statistic & NOSA informed	30		
4.20 INVESTIGATION of accidents & remedial measures taken to prevent recurrence	60		
SECTION RATING	150	%	
5.00 SAFETY ORGANIZATION			
5.10 SAFETY PERSONNEL			
5.11 One person made responsible for safety	30		
5.12 Factory regulations	30		
5.13 European S. Committee	80		
5.14 Non European safety Committee	40		
5.15 First aider & equipment	20		
5.16 First aid training	30		
5.20 SAFETY PROPAG.			
5.21 Poster, bulletin, letters	130		
5.22 Notice board	20		
5.23 Suggestion scheme	20		
5.30 INDUCTION TRAINING AND JOB INSTRUCTION	50		
5.40 PLANT INSPECTION	50		
5.50 WRITTEN SAFE OPERATING PRACTICES	50		
5.60 ITEM NOT DETAILED			
5.61 COMPANY POLICY	100		
5.62 Bonus & Penalty			
SECTION RATING	650		
OVERALL RATING		%	

Figure 4.2: Safety Effort Survey/Rating

SOURCE: James J. O'Brien and Robert G. Zilly, (1991). "Contractor's Management Handbook", Second Edition, McGraw-Hill, Inc., New York

CIRCLE THE NUMBER OF POINTS YOU AWARD YOURSELF ON EACH ITEM

	1. Safety Goals or Objectives	Points
Poor	No formal safety and loss prevention goals exist.	0
Fair	Safety and loss prevention goals for my staff & me are discussed in loose terms. Goals may be recorded on paper but reviews if any needs	5
Good	Formal goals are established for my staff and me and are reviewed each year.	7
Excellent	Sound but flexible goals are established for each individual and reviewed & updated at least quarterly	10

	2. Safety Meetings	Points
Poor	I am never involved in a safety meetings	0
Fair	I occasionally encourage my subordinates to hold safety meetings for their employee.	5
Good	I arrange an occasional safety meeting, i.e., at least once a year for all employees under my direction & actively follow progress of the safety meeting programs held by my subordinates.	7
Excellent	In addition to criteria for "Good" I periodically drop in on one of the regular monthly safety meetings held some place in my organization.	10

	3. Safety Promotion activities	Points
Poor	No general safety promotion made.	0
Fair	Endorse general safety promotion program carried on by others	5
Good	Participate enough with planning committees to see that active, imaginative safety promotion campaigns are carried out.	7
Excellent	Lend support of presence & active open participation in safety promotion activity making my interest in the subject widely visible to the plant and/or the community. I actively participate in special safety campaigns, send out promotional letters to the homes, vigorously support safety efforts of my subordinates.	10

	4. Accident Investigations	Points
Poor	Receive only brief oral report immediately following an accident & ultimately get a copy of the final report.	2
Fair	Get an oral briefing following the incident & make a formal review with the investigating committee, following up on all personal disabling injury reports.	5
Good	Participate in a formal review following disabling injuries, serious injuries, near miss accidents requiring committee reports, & major property loss incidents.	7
Excellent	In addition to "Good", assign responsibility, target dates and periodic follow-up of recommendations of the investigating committees.	10

	5. Executive Safety Activities	Points
Poor	No established committee or committee exists on paper only.	2
Fair	Committee exists, meetings may be irregular & plant manager is not an active part of the committee.	5
Good	Have an active executive committee with regular meetings, published minutes, & the plant manager is usually personally involved.	7
Excellent	Have an active committee, regular meetings, agenda prepared in advance of the meeting with plant manager guidance, & publish minutes following meeting. Plant manager chairs the committee, assign specific safety tasks to committee members.	10

	6. Rating of Subordinates on Safety Performance	Points
Poor	No judgments made concerning subordinates safety performance.	0
Fair	Subordinates' safety performance included as an item in job responsibilities and gets some mention in annual review	5
Good	Safety & loss prevention responsibilities & duties of subordinates are clearly delineated in his job description & are made a specific separate & formal part of the job performance review	7
Excellent	Same as "Good" above, plus general understanding that rating in this responsibility are at least equal to other duties in determining safety changes & promote-ability of subordinates.	10

	7. Enforcement of Safety Rules & Procedures	Points
Poor	No established safety rules & procedures, or such rules & procedures exist only on paper.	2
Fair	Safety rules & procedures exist. Employees are aware of procedures & procedures are reviewed with employees on regular basis. Enforcement of rules/procedures is weak or non-existent.	5
Good	Have written rules & procedures that are regularly reviewed & updated. Supervision is expected to enforce compliance, but there is little or no active participation by you or your staff.	7
Excellent	Written safety rules & procedures are considered an integral part of other work rules and are subject to same disciplinary actions. They are reviewed annually by management & labor task force. Program is actively supported by all level of plant management.	10

	8. Support of Safety & Loss Prevention Audits	Points
Poor	Receive brief oral report following audit & ultimately receive a copy of the final report. Audit schedule is on a hit-or-miss basis.	2
Fair	Get oral briefing during or following the audit, & a staff member makes a formal review with the audit committee. Audit schedule exists, but is followed very loosely.	5
Good	Oral briefing is provided immediately following the audit. Participate in formal review of published audit where any major deficiencies are noted. Audit schedule is established & followed.	7
Excellent	In addition to "Good", assign responsibility, target dates, & periodic follow-up of recommendations of the audit committee.	10

	9. Follow-up on Hazard Correction	Points
Poor	No procedure or system established to inform you of the disposition of hazard correction recommendations.	0
Fair	Hazard correction procedure exists, but you receive no reports indicating progress or action on hazard correction.	5
Good	Follow-up procedures established and you routinely receive reports of progress on hazard correction.	7
Excellent	Same as "Good", but you comment on reports of progress on hazard correction to indicate that you are interested in the outcome, lack of progress, satisfied with method of handling, etc.	10

	10. Communicating/Sharing Safety Program Activities	Points
Poor	Activities of your plant and results of efforts in your plant are not communicated to peers.	2
Fair	Results of programs and on-going activities in your plant are communicated to peers on a "hit-and-miss" basis.	5
Good	Safety activities of your plant are exchanged with peers at periodic managers' meetings as a scheduled part of the agenda.	7
Excellent	In addition to "Good", a program exists where you share experiences with other plants on a regular basis through regularly transmitted written material for mutual benefit.	10

Figure 4.3: Loss Prevention Self-Appraisal Form For Manager

SOURCE: Partlow, H., (1974). "Loss Prevention Self-appraisal for Manager." McGraw-Hill Book Co., Inc., New York

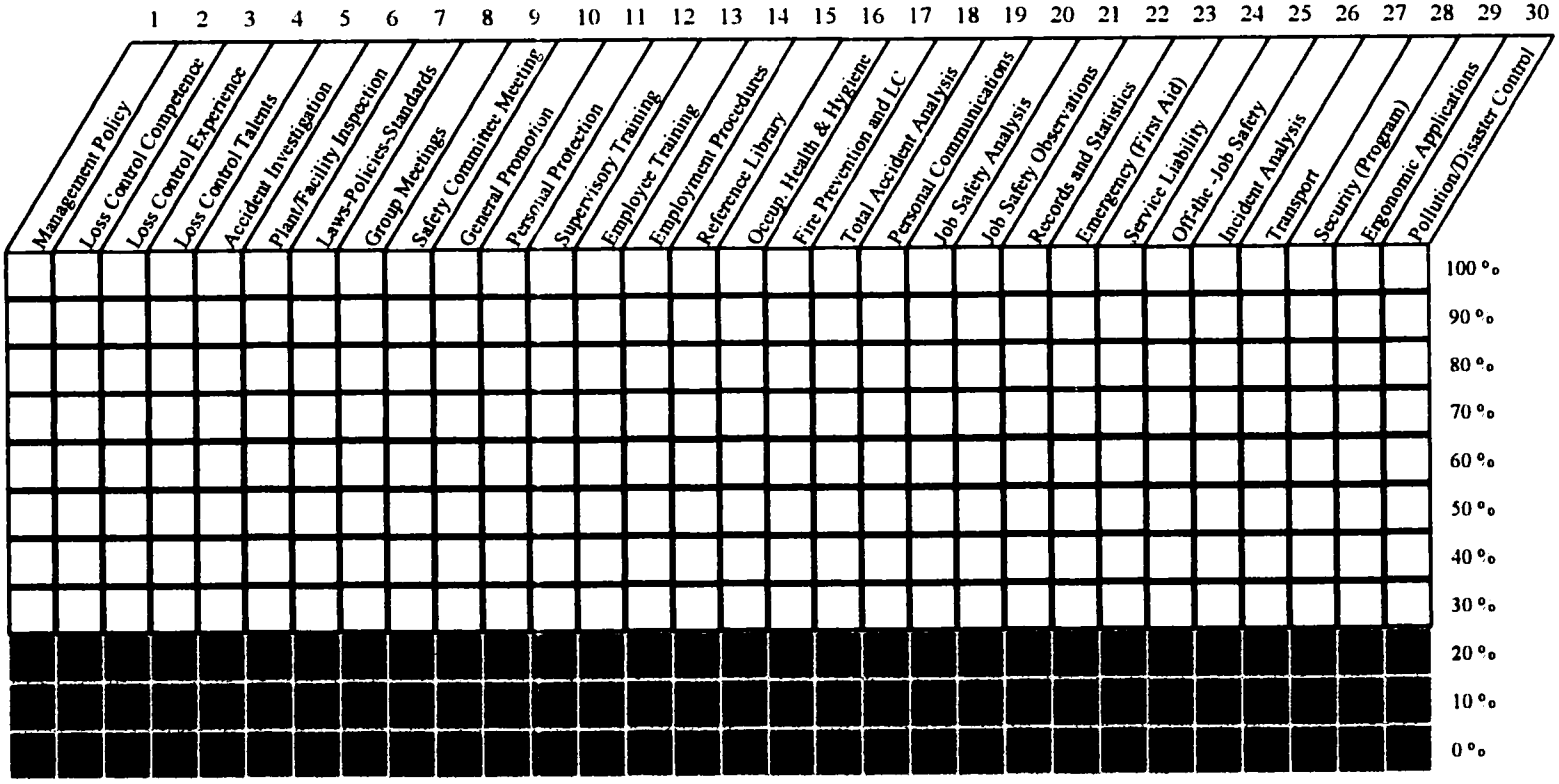

Figure 4.4: Master Development and Evaluation Grid

Source: Peterson, D., (1980), "Analyzing Safety Performance", Garland STPM Press, New York, USA.

4.4 PC-BASED EVALUATION TOOL CONCEPT

The PC-based tool which has been developed utilizes a dimensional weighting approach based on multiple-criteria for measuring contractor safety performance. In this dimensional weighting, each factor and sub-factor used for the evaluation and its weights are determined as a result of the preferences expressed by the contractor. Once these factors and the associated weights are established, the Contractor Safety Performance can then be rated with respect to each factor and sub-factor. The scores of the contractor are calculated as a weighted sum of all ratings over all the factors and sub-factors.

In order to develop the computerized tool, there are two types of parameters that need to be determined. These are the main factor (MF) and the sub-factor (SF). The MF represents a single constituent made up of interrelated sub-factors (SF). Thus, a MF reduces the number of relevant parameters utilized in the actual performance measurement process. For example, a main factor called Concrete and Concrete Formworks can be characterized by five sub-factors, namely, the work platform / guardrails, grounded electric vibrator, experienced workmanship, shoring sketches / drawings on site, and forms / adequate shoring for supports, as shown in Figure 4.5. A sub-factor can then be defined as a partial contributor to the safety performance measurement process.

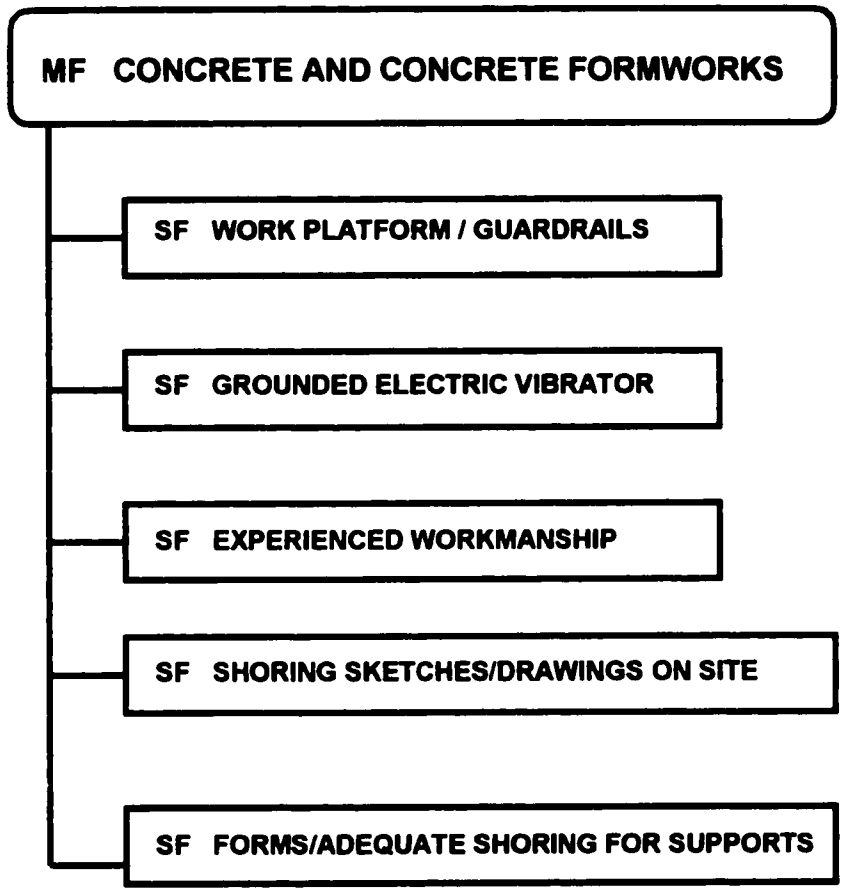

Figure 4.5: Example of Influencing Factor Structure

Once the main factors and their associated sub-factors upon which the contractor safety performance will be evaluated are determined, the user will proceed to give each a weight according to its influence. The weight of the MF is calculated with respect to other MFs in the process. Likewise, the weight of the SF is calculated with respect to other SFs contained in a single MF, as will be shown in section 4.6.

4.5 ADVANTAGES OF THE COMPUTERIZED TOOL

The advantages of the tool which has been developed are as follows:

4.5.1 The tool is simple and understandable to the user (contractor).

4.5.2 The tool provides a systematic, structured approach to the evaluation of contractor safety performance against the predetermined main and sub-factors and their weights.

4.5.3 The tool is flexible as it allows the user to change the weights of the main factors / sub-factors, edit/view specific data, add new factors / sub-factor, and delete existing ones.

4.5.4 It starts with an explanation screen to give the user a brief description of the safety performance measurement process.

4.5.5 The main menu provides a help option to give the user step-by-step directions to complete the performance measurement process.

4.5.6 The user has the option to exit at any stage of the evaluation process.

4.6 CALCULATION OF THE TOOL PARAMETERS

The main factors and sub-factors will enable the individual who performs the measurement to determine the extent to which each factor and sub-factor impacts the measurement process. This will be achieved by using a scale from zero, which means no impact (zero weight), through two, which means moderate impact, to four, which means very high impact or weight.

The responses for each main factor will be translated to weights according to the following steps:

4.6.1 Calculate the mean impact for each sub-factor included in each main factor.

The rating scale used is as follow:

Very high impact	=	4
High impact	=	3
Moderate impact	=	2
Little impact	=	1
No impact	=	0

4.6.2 Calculate the weight of each sub-factor using the following equation:

$$W_{ij} = SFMI_{ij} / \sum SFMI_{ij} \quad (1)$$

where:

Wij = The weight of the sub-factor j that is associated with the main factor i

SFMI ij = The mean impact of the sub-factor j that is associated with the main factor i

4.6.3 Calculate the mean impact of the main factor using the following equation:

$$MFMI_i = \sum SMFMI_{ij} / mi \quad (2)$$

Where:

MFMI i = mean impact of main factor i

SFMI ij = mean impact of sub-factor j in the main factor i

Mi = the number of sub-factors in the main factor

4.6.4 Calculate the weight of the main factor using the following equation:

$$W_i = MFMI_i / \sum MFMI_i \quad (3)$$

4.6.5 To find the aggregate weight score of the contractor, apply the following equation:

$$AWS = \sum_{i}^{n} W_i * \left[\sum_{j}^{m} (W_{ij})(R_{ij}) \right] \quad (4)$$

Where:

AWS = aggregate weight rating for the contractor

n = number of main factors

m = number of sub-factors in the main factor

Wij = weight of sub-factor in the main factor

Wi = weight of main factor

Rij = score of the sub-factor j in the main factor j for the Contractor on a scale of 1.0 to 10.0 (refer to Table 4.2)

1.0 is Poor

10.0 is Excellent for the specific project

It should be realized that up to this point, only the weights of both (MFs) and their characterized (SFs) have been calculated. However, equation 4 at step 5 above still cannot be applied because it has one important unknown which is R ij that must be found or calculated for each factor. This could be achieved by running the developed PC-based tool for any industrial construction contractor, for any specific project.

4.6.6 To find the contractor safety performance, apply the following equation:

$$SP = AWS^{*} [W_{max} / (W_{max} - W_{na})] \quad (5)$$

Where:

SP = safety performance

AWS = aggregate weight rating of the contractor

Wmax = maximum attainable weight

Wna = weight of non-applicable factors

CHAPTER FIVE

DATA ANALYSIS AND RESULTS

5.1 DATA ANALYSIS AND SCORING

Data gathered from the questionnaire and the interviews was used to identify the main and sub-factors which affect the safety performance of the construction contractor. The level of importance of these main and sub-factors was ranked according to their priority. The mean impact and the weight of each factor and sub-factor were calculated using equations 1, 2, & 3, as shown in chapter 4.

The respondents had five options for each question; these options are:

Very high impact	corresponding to 4 points
High impact	corresponding to 3 points
Moderate impact	corresponding to 2 points
Low impact	corresponding to 1 points
No impact	corresponding to 0 points

The mean impact of each sub-factor is calculated as shown in the sample calculation in Table 5.1.

Table 5.1: Sample Calculation of Mean Impact of Sub-Factors

No.	Sub-Factor	4 Very High	3 High	2 Moderate	1 Low	0 No Impact
		No. of Participants Marked				
12.1	Head/Eye/Face/Hand/Foot and Hearing Protection	25	0	0	0	0

$$\text{Mean Impact} = \frac{(25 \times 4) + (0 \times 3) + (0 \times 2) + (0 \times 1) + (0 \times 0)}{(25 + 0 + + 0 + 0 + 0)} = 4.0$$

5.2 SAMPLE SURVEY

In this study the sample survey was selected from the "Top 1000 Saudi Companies Directory" fourth edition 1995-1996, published by International Information and Trading Services Company. A sample of 28 companies was selected from the industrial contractors who are involved with large volumes of industrial construction activities in the Eastern Province. A total of 28 questionnaires were distributed among the industrial construction contractors. The questionnaire was personally handed over to the respondents, and an interviewer was available to answer any questions relating to the questionnaire. A total of 25 questionnaires were returned, which represents an overall return rate of 89%. Table 34 shows the total sample and the respondents. The names and addresses of the companies are shown in Appendix (C).

Table 5.2: Number of Companies Surveyed

No.	Description	Number of Questionnaires	Percentage
1	Total number of questionnaires distributed	28	100
2	Total number of completed questionnaires returned	25	89

5.2.1 The Categories into which the Respondents Fall in the Survey

The respondent categories, which indicate the construction activities they are typically involved with, are shown in Table 5.3. All of the respondents were involved in Industrial Construction, which represents 100 %. General Building (nonresidential) construction was the next highest with 72.0%, followed by Refinery Project Construction at 48.0 percent. Utilities Construction and Highway Construction had nearly the same percentages, with 12.0 and 8.0 respectively.

Table 5.3: Categories of Companies Participating in the Survey

No	Category of Companies	Number of Companies	Percent %
1	Industrial Construction	25	100
2	General Building Construction	18	72
3	Refinery Project Construction	12	48
4	Utilities Construction	3	12
5	Highway Construction	2	8

Note: Most of the (25) companies who participated in the survey are involved in more than one category of work.

5.2.2 Respondents' Safety Program Quality Assurance

All of the respondents use the Industrial Disabling Injury (IDI) Frequency Rate as a main technique for safety program quality assurance (QA), which represents a percentage of 100 %. The Industrial Disabling Injury Severity Rate and the Incident Rate were monitored by 60 % and 76 % of the respondents, respectively. Other techniques of safety program quality assurance which were reported by the respondents include safety training, safety inspection, safety discussion, and using one or more full-time safety specialists. The categories of the safety program quality assurance techniques of the respondents are shown in Table 5.4.

Table 5.4: Categories of Quality Assurance Techniques in Safety Program

No.	Category of Safety Program Quality Assurance Techniques	Number of Companies	Percent %
1	Disabling Injury Frequency Rate	25	100
2	Disabling Injury Severity Rate	15	60
3	Incident Rate	19	76

Note: Most of the (25) companies who participated in the survey maintain adequate records for one or more of the above safety program quality assurance techniques.

5.3 CALCULATION OF THE WEIGHTS OF THE INFLUENCING FACTORS

The objective of calculating the mean impacts of the main and sub-factors is to calculate the weights these factors carry so that the equation used for the PC-based tool

can be solved (see chapter four, page 74). The mean impact of the sub-factors listed in the questionnaire was calculated according to the method presented in Table 5.1, using the Microsoft Excel Program. The results are shown in Table 5.5. By applying equation 4, shown in that chapter, weights of the main factor (MF) based on the overall mean impact of the whole sample are calculated and the results are shown in Table 5.6. A graphical representation of the influencing factors vs. their weights is shown in Figure 5.1. In calculating the sub-factor (SF) weights, however, equation 1 needs to be applied. The results of this application are shown in Table 5.7.

Table 5.5: Calculated Mean Impact of Sub-Factors Listed in Questionnaire (Continued)

No.	FACTORS AND SUB-FACTORS DESCRIPTION	4 VERY HIGH	3 HIGH	2 MODE RATE	1 LOW	0 NO IMPACT	MEAN IMPACT
1.0	**SITE PLANNING AND HOUSEKEEPING**						
1.1	Site Layout	4	16	5	0	0	2.96
1.2	Safe Means of Access & Exit	0	19	6	0	0	2.76
1.3	Site illumination	0	4	21	0	0	2.16
2.0	**WELFARE FACILITIES**						
2.1	First Aid Facilities	15	9	0	1	0	3.52
2.2	Food and Drinking Water Facilities	0	4	21	0	0	2.16
2.3	Ambulance	15	5	4	1	0	3.36
2.4	Showers and Eyewash Fountains	5	13	6	1	0	2.88
2.5	Smoking Area / Toilet and Washing Facilities	4	2	9	10	0	2.00
3.0	**EMERGENCY/DISASTER PLANNING AND PREPARATION**						
3.1	Emergency Response Organization / Procedures	25	0	0	0	0	4.00
3.2	Emergency Response Training / Drills	25	0	0	0	0	4.00
4.0	**SIGNS, SIGNALS AND BARRICADES**						
4.1	General Signs (Danger, Caution, Traffic, and Accident Prevention Tags)	7	18	0	0	0	3.28
4.2	Flag Men / Wearing Garment (Red or Orange)	6	15	4	0	0	3.08
4.3	Signaling Direction (As per ANSI)	11	14	0	0	0	3.44
4.4	Crane and Hoist Signals (As per ANSI)	11	14	0	0	0	3.44

Table 5.5: Calculated Mean Impact of Sub-Factors Listed in Questionnaire (Continued)

No.	FACTORS AND SUB-FACTORS DESCRIPTION	4 VERY HIGH	3 HIGH	2 MODE RATE	1 LOW	0 NO IMPACT	MEAN IMPACT
5.0	**MATERIALS HANDLING, STORAGE AND USE**						
5.1	Aisles and Driveways	4	6	15	0	0	2.56
5.2	Fence and Access Gates	0	13	8	4	0	2.36
5.3	Arrangement of Materials	0	20	1	4	0	2.64
5.4	Fire Protection Equipment	23	2	0	0	0	3.92
6.0	**WELDING AND CUTTING**						
6.1	Handling of Cylinders	6	5	14	0	0	2.68
6.2	Daily Inspection of Equipment	0	21	3	1	0	2.80
6.3	Adequate Ventilation	2	16	7	0	0	2.80
6.4	Grounding / Fire Guard	20	5	0	0	0	3.80
6.5	Personal Protective Equipment	19	5	1	0	0	3.72
7.0	**CONCRETE, AND CONCRETE FORMWORKS**						
7.1	Work Platform / Guardrails	0	20	4	0	0	2.72
7.2	Grounded Electric Vibrator	17	0	5	3	0	3.24
7.3	Experienced Workmanship	10	15	0	0	0	3.40
7.4	Shoring Sketches / Drawings on Site	0	19	6	0	0	2.76
7.5	Forms / Adequate Shoring For Supports	10	14	1	0	0	3.36
8.0	**CRANE AND LIFTING EQUIPMENT**						
8.1	Lift Plan on Site	18	7	0	0	0	3.72
8.2	Licensed Operators	21	4	0	0	0	3.84
8.3	Safe Working Load Indicator / Inspection Stickers	16	9	0	0	0	3.64
8.4	Safety Latches (Hooks)	20	4	1	0	0	3.76
8.5	Rigger Training	15	10	0	0	0	3.60

Table 5.5: Calculated Mean Impact of Sub-Factors Listed in Questionnaire (Continued)

No.	FACTORS AND SUB-FACTORS DESCRIPTION	4 VERY HIGH	3 HIGH	2 MODE RATE	1 LOW	0 NO IMPACT	MEAN IMPACT
9.0	**CHEMICAL HANDLING**						
9.1	Proper Identification / Warning Signs (Arabic / English)	22	2	1	0	0	3.84
9.2	Adequate Storage / Usage	0	14	11	0	0	2.56
9.3	Emergency Treatment	10	15	0	0	0	3.40
10.0	**ELECTRICAL EQUIPMENT**						
10.1	Temporary Installation Precautions	4	20	1	0	0	3.12
10.2	Lockout / Tagging / Warning Signs	11	14	0	0	0	3.44
10.3	Initial Inspection / Tests	10	13	2	0	0	3.32
10.4	Testing of Grounds	18	7	0	0	0	3.72
11.0	**HANDLING, TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIAL AND WASTE**						
11.1	Hazard Identification Plan	21	3	1	0	0	3.80
11.2	Waste Management Plan	0	25	0	0	0	3.00
11.3	Disposal Sites / Disposal Documents	0	9	16	0	0	2.36
12.0	**PERSONAL PROTECTIVE EQUIPMENT**						
12.1	Head / Eye / Face / Hand / Foot, and Hearing Protection	25	0	0	0	0	4.00
12.2	Fall Restraining / Arresting Devices	25	0	0	0	0	4.00
12.3	Breathing Apparatus	25	0	0	0	0	4.00

Table 5.5: Calculated Mean Impact of Sub-Factors Listed in Questionnaire (Continued)

No.	FACTORS AND SUB-FACTORS DESCRIPTION	4 VERY HIGH	3 HIGH	2 MODE RATE	1 LOW	0 NO IMPACT	MEAN IMPACT
13.0	**FIRE PREVENTION**						
13.1	Adequate Fire Extinguisher / Locations	25	0	0	0	0	4.00
13.2	Control of Ignition Sources / Fire Watches	14	7	4	0	0	3.40
13.3	Storage of Flammable Liquids / Combustible Materials	16	9	0	0	0	3.64
13.4	Fire Extinguisher Training / Drills	15	6	4	0	0	3.44
13.5	Fire Extinguishers Regular Maintenance	4	18	3	0	0	3.04
14.0	**TRANSPORTATION**						
14.1	Vehicle Condition / Regular Maintenance	2	21	2	0	0	3.00
14.2	Passenger Seating / Seat Belts Enforcement	2	21	2	0	0	3.00
14.3	Motor Vehicle Regulations (Saudi Arabian Government)	5	17	3	0	0	3.08
14.4	First Aid Equipment / Fire Extinguishers	15	10	0	0	0	3.60
14.5	Driver Training	14	8	3	0	0	3.44
15.0	**EXCAVATION, TRENCHING AND SHORING**						
15.1	Cave-in Protection (Shoring / Trench Boxes / Sloping / Benching)	8	17	0	0	0	3.32
15.2	Excavations Plan On Site	8	19	3	0	0	3.00
15.3	Access , Exits and Walkways	19	6	0	0	0	3.76

Table 5.5: Calculated Mean Impact of Sub-Factors Listed in Questionnaire (Continued)

No.	FACTORS AND SUB-FACTORS DESCRIPTION	4 VERY HIGH	3 HIGH	2 MODE RATE	1 LOW	0 NO IMPACT	MEAN IMPACT
16.0	**SCAFFOLDING AND LADDERS**						
16.1	Adequate Components and Fittings (Frame Members / Base & Sole Plates / Plumb & Level / Planking)	19	6	0	0	0	3.76
16.2	Experienced Workmanship	18	7	0	0	0	3.72
16.3	Scaffold Access and Proper Loading	17	8	0	0	0	3.68
16.4	Adequate Scaffolding Stability (Guardrails / Toeboards / Secured Ties / Foundations and Cross Bracing)	23	2	0	0	0	3.92
17.0	**HAND AND POWER TOOLS**						
17.1	Overall Condition / Daily Inspection	0	20	5	0	0	2.80
17.2	Individual Tools Precautions	0	10	15	0	0	2.40
17.3	Selection / Training	1	10	14	0	0	2.48
18.0	**MECHANICAL EQUIPMENT**						
18.1	Qualified and Certified Operators	13	12	0	0	0	3.52
18.2	Machinery Guards and Safety Protection Devices	17	7	1	0	0	3.64
18.3	Regular Inspections and Strict Maintenance Schedules	0	24	0	1	0	2.92
19.0	**IONIZATION RADIATION**						
19.1	Health Hazard Identification	25	0	0	0	0	4.00
19.2	Protection Against Radiation (Distance, Time and Shielding)	24	1	0	0	0	3.96

Table 5.5: Calculated Mean Impact of Sub-Factors Listed in Questionnaire (Continued)

No.	FACTORS AND SUB-FACTORS DESCRIPTION	4 VERY HIGH	3 HIGH	2 MODE RATE	1 LOW	0 NO IMPACT	MEAN IMPACT
19.3	Adequate Training and Safe Handling	22	3	0	0	0	3.88
19.4	Intensive Inspection Each Shift	17	7	1	0	0	3.64
19.5	Shipping / Transportation / Storage Areas	16	8	1	0	0	3.60
20.0	**MANAGEMENT INVOLVEMENT**						
20.1	Initiate / Administer Company's Safety Policy	25	0	0	0	0	4.00
20.2	Know and Adhere to the Requirements of Workmen's Regulations	25	0	0	0	0	4.00
20.3	Ensure Qualified and Well Trained Supervisors	25	0	0	0	0	4.00
20.4	Consider Safety at Tendering, Planning & Contract	25	0	0	0	0	4.00
20.5	Institute and Adhere to Loss Prevention Program	25	0	0	0	0	4.00
20.6	Fix Accountability of Safety	25	0	0	0	0	4.00
20.7	Set a Personal Example	25	0	0	0	0	4.00
20.8	Prepare Hazard Identification Plan	25	0	0	0	0	4.00
20.9	Prepare Emergency Evacuation Procedures	25	0	0	0	0	4.00
20.10	Communicate & Share Safety Program Activities, Experience and Results with Others	25	0	0	0	0	4.00
20.11	Safety Motivation (Group Meeting, Literature, Film Show, Posters, Bulletin Boards, Incentives)	25	0	0	0	0	4.00

Table 5.6: Calculation of Weights of Main Factors Based on Overall Mean Impact

MF	Number of SF in MF	Σ SFMI$_{ij}$	MF Mean Impact (MF$_i$)	MF Weight (W$_i$)
1	3	7.88	2.63	0.039
2	5	13.92	2.78	0.042
3	2	8.00	4.00	0.060
4	4	13.24	3.31	0.050
5	4	11.48	2.87	0.043
6	5	15.80	3.16	0.047
7	5	15.48	3.10	0.046
8	5	18.56	3.71	0.056
9	3	9.80	3.27	0.049
10	4	13.60	3.40	0.051
11	3	9.16	3.05	0.046
12	3	12.00	4.00	0.060
13	5	17.52	3.50	0.052
14	5	16.12	3.22	0.048
15	3	10.08	3.36	0.050
16	4	15.08	3.77	0.056
17	3	7.68	2.56	0.038
18	3	10.08	3.36	0.050
19	5	19.08	3.82	0.057
20	11	44.00	4.00	0.060
TOTAL			**66.87**	**1.000**

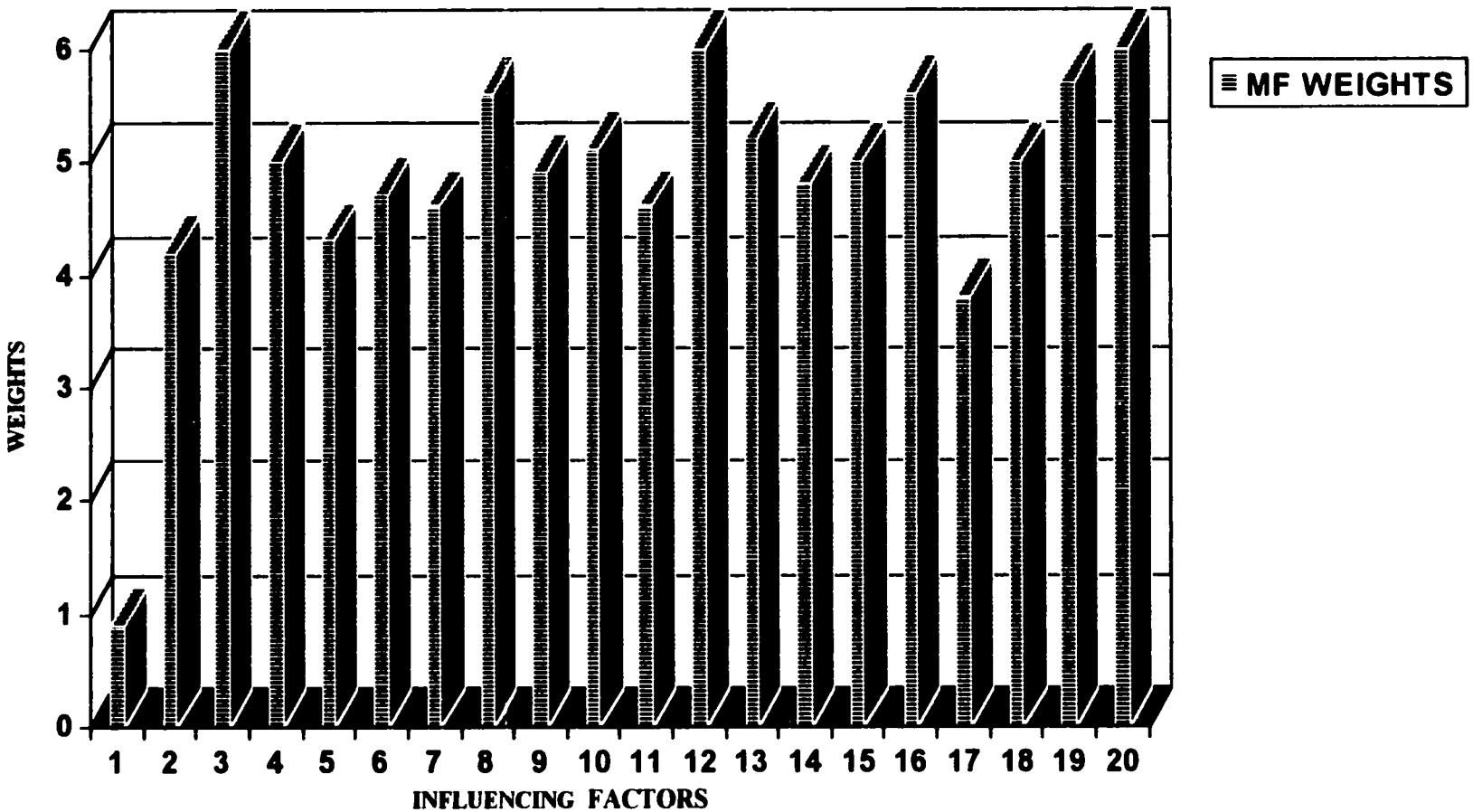

Figure 5.1: Influencing Factors vs. Weights

Table 5.7: Mean Impact and Weights of Factors and Sub-Factors Listed in Questionnaire

No.	DESCRIPTION OF FACTORS AND SUB-FACTORS	MEAN IMPACT	WEIGHT
1.0	**SITE PLANNING AND HOUSEKEEPING**	**2.63**	**0.039**
1.1	Site Layout	2.96	0.38
1.2	Safe Means of Access and Exit	2.76	0.35
1.3	Site illumination	2.16	0.27
2.0	**WELFARE FACILITIES**	**2.78**	**0.042**
2.1	First Aid Facilities	3.52	0.25
2.2	Food and Drinking Water Facilities	2.16	0.16
2.3	Ambulance	3.36	0.24
2.4	Showers and Eyewash Fountains	2.88	0.21
2.5	Smoking Area / Toilet and Washing Facilities	2.00	0.14
3.0	**EMERGENCY / DISASTER PLANNING AND PREPARATION**	**4.0**	**0.06**
3.1	Emergency Response Organization / Procedures	4.0	0.50
3.2	Emergency Response Training / Drills	4.0	0.50
4.0	**SIGNS, SIGNALS AND BARRICADES**	**3.31**	**0.049**
4.1	General Signs (Danger, Caution, Traffic, and Accident Prevention Tags)	3.28	0.25
4.2	Flag Men / Wearing Garment (Red or Orange)	3.08	0.23
4.3	Signaling Direction (As per ANSI)	3.44	0.26
4.4	Crane and Hoist Signals (As per ANSI)	3.44	0.26

Table 5.7: Mean Impact and Weights of Factors and Sub-Factors Listed in Questionnaire (Continued)

No.	DESCRIPTION OF FACTORS AND SUB-FACTORS	MEAN IMPACT	WEIGHT
5.0	**HANDLING, STORAGE AND USE OF MATERIALS**	**2.87**	**0.043**
5.1	Aisles and Driveways	2.56	0.22
5.2	Fence and Access Gates	2.36	0.21
5.3	Arrangement of Materials	2.64	0.23
5.4	Fire Protection Equipment	3.92	0.34
6.0	**WELDING AND CUTTING**	**3.16**	**0.047**
6.1	Handling of Cylinders	2.68	0.17
6.2	Daily Inspection of Equipment	2.80	0.18
6.3	Adequate Ventilation	2.80	0.18
6.4	Grounding / Fire Guard	3.80	0.24
6.5	Personal Protective Equipment	3.72	0.23
7.0	**CONCRETE, AND CONCRETE FORMWORKS**	**3.10**	**0.046**
7.1	Work Platform / Guardrails	2.72	0.17
7.2	Grounded Electric Vibrator	3.24	0.21
7.3	Experienced Workmanship	3.40	0.22
7.4	Shoring Sketches / Drawings on Site	2.76	0.18
7.5	Forms / Adequate Shoring For Supports	3.36	0.22
8.0	**CRANE AND LIFTING EQUIPMENT**	**3.71**	**0.056**
8.1	Lift Plan on Site	3.72	0.20
8.2	Licensed Operators	3.84	0.21
8.3	Safe Working Load Indicator / Inspection Stickers	3.64	0.20
8.4	Safety Latches (Hooks)	3.76	0.20
8.5	Rigger Training	3.60	0.19

Table 5.7: Mean Impact and Weights of Factors and Sub-Factors Listed in Questionnaire (Continued)

No.	DESCRIPTION OF FACTORS AND SUB-FACTORS	MEAN IMPACT	WEIGHT
9.0	**CHEMICAL HANDLING**	**3.27**	**0.049**
9.1	Proper Identification / Warning Signs (Arabic / English)	3.84	0.33
9.2	Adequate Storage / Usage	2.56	0.30
9.3	Emergency Treatment	3.40	0.37
10.0	**ELECTRICAL EQUIPMENT**	**3.40**	**0.051**
10.1	Temporary Installation Precautions	3.12	0.23
10.2	Lockout / Tagging / Warning Signs	3.44	0.25
10.3	Initial Inspection / Tests	3.32	0.24
10.4	Testing of Grounds	3.72	0.28
11.0	**HANDLING, TRANSPORTATION AND DISPOSAL OF HAZARDOUS MATERIAL AND WASTE**	**3.05**	**0.046**
11.1	Hazard Identification Plan	3.80	0.41
11.2	Waste Management Plan	3.00	0.33
11.3	Disposal Sites / Disposal Documents	2.36	0.26
12.0	**PERSONAL PROTECTIVE EQUIPMENT**	**4.00**	**0.060**
12.1	Head / Eye / Face / Hand / Foot, and Hearing Protection	4.00	0.34
12.2	Fall Restraining / Arresting Devices	4.00	0.33
12.3	Breathing Apparatus	4.00	0.33

Table 5.7: Mean Impact and Weights of Factors and Sub-Factors Listed in Questionnaire (Continued)

No.	DESCRIPTION OF FACTORS AND SUB-FACTORS	MEAN IMPACT	WEIGHT
13.0	**FIRE PREVENTION**	**3.50**	**0.052**
13.1	Adequate Fire Extinguishers / Locations	4.00	0.23
13.2	Control of Ignition Sources / Fire Watches	3.40	0.19
13.3	Storage of Flammable Liquids / Combustible Materials	3.64	0.21
13.4	Fire Extinguisher Training / Drills	3.44	0.20
13.5	Fire Extinguishers Regular Maintenance	3.04	0.17
14.0	**TRANSPORTATION**	**3.22**	**0.048**
14.1	Vehicle Condition / Regular Maintenance	3.00	0.19
14.2	Passenger Seating / Seat Belts Enforcement	3.00	0.19
14.3	Motor Vehicle Regulations (Saudi Arabia Government)	3.08	0.19
14.4	First Aid Equipment / Fire Extinguishers	3.60	0.22
14.5	Driver Training	3.44	0.21
15.0	**EXCAVATION, TRENCHING AND SHORING**	**3.36**	**0.050**
15.1	Cave-in Protection (Shoring / Trench Boxes / Sloping / Benching)	3.32	0.33
15.2	Excavations Plan On Site	3.00	0.30
15.3	Access , Exits and Walkways	3.76	0.37

Table 5.7: Mean Impact and Weights of Factors and Sub-Factors Listed in Questionnaire (Continued)

No.	DESCRIPTION OF FACTORS AND SUB-FACTORS	MEAN IMPACT	WEIGHT
16.0	**SCAFFOLDING AND LADDERS**	**3.77**	**0.056**
16.1	Adequate Components and Fittings (Frame Members / Base & Sole Plates / Plumb & Level / Planking)	3.76	0.25
16.2	Experienced Workmanship	3.72	0.25
16.3	Scaffold Access and Proper Loading	3.68	0.24
16.4	Adequate Scaffolding Stability (Guardrails / Toeboards / Secured Ties / Foundations and Cross Bracing)	3.92	0.26
17.0	**HAND AND POWER TOOLS**	**2.56**	**0.038**
17.1	Overall Condition / Daily Inspection	2.80	0.37
17.2	Individual Tools Precautions	2.40	0.31
17.3	Selection / Training	2.48	0.32
18.0	**MECHANICAL EQUIPMENT**	**3.36**	**0.050**
18.1	Qualified and Certified Operators	3.52	0.35
18.2	Machinery Guards and Safety Protection Devices	3.64	0.36
18.3	Regular Inspections and Strict Maintenance Schedules	2.92	0.29

Table 5.7: Mean Impact and Weights of Factors and Sub-Factors Listed in Questionnaire (Continued)

No.	DESCRIPTION OF FACTORS AND SUB-FACTORS	MEAN IMPACT	WEIGHT
19.0	**IONIZATION RADIATION**	**3.82**	**0.057**
19.1	Health Hazard Identification	4.00	0.21
19.2	Protection Against Radiation (Distance, Time and Shielding)	3.96	0.21
19.3	Adequate Training and Safe Handling	3.88	0.20
19.4	Intensive Inspection Each Shift	3.64	0.19
19.5	Shipping / Transportation / Storage Areas	3.60	0.19
20.0	**MANAGEMENT INVOLVEMENT**	**4.00**	**0.060**
20.1	Initiate / Administer Company's Safety Policy	4.00	0.10
20.2	Know and Adhere to the Requirements of Workmen's Regulations	4.00	0.09
20.3	Ensure Qualified and Well Trained Supervisors	4.00	0.09
20.4	Consider Safety at Tendering, Planning & Contract	4.00	0.09
20.5	Institute and Adhere to Loss Prevention Program	4.00	0.09
20.6	Fix Accountability of Safety	4.00	0.09
20.7	Set a Good Personal Example	4.00	0.09
20.8	Prepare Hazard Identification Plan	4.00	0.09
20.9	Prepare Emergency Evacuation Procedures	4.00	0.09
20.10	Communicate & Share Safety Program Activities, Experience and Results with Others	4.00	0.09
20.11	Safety Motivation (Group Meeting, Literature, Film Show, Posters, Bulletin Boards, Incentives)	4.00	0.09

CHAPTER SIX

A PC-BASED EVALUATION TOOL FOR MEASUREMENT OF SAFETY PERFORMANCE

6.1 INTRODUCTION

A PC-based evaluation tool can significantly accelerate the safety performance measurement process, and be an aid to industrial contractors by helping them to continuously monitor this fundamental issue. This section presents the PC-based tool which will be called the Contractor Safety Performance Measurement Program (CSPMP). This program will calculate the aggregate weighted rating scores of the contractor based on the input scores for each main factor and sub-factor. This program can be used by the contractor, at any time, to determine his safety performance level and take the necessary proactive actions to correct any deficiencies in his safety management program.

Two computer programming techniques were evaluated to develop the proposed PC-based tool, for the contractor safety performance measurement. The two methods are the Knowledge-Based Expert System (KBES), and sequential programming using Visual Basic.

Expert Systems are computer programs that incorporate human expertise to provide advice on a wide range of topics developed from knowledge bases, which contain knowledge collected from all possible sources, mainly with the help of an expert practitioner. These systems function as consultants in the given domain to provide explanations of reasoning, simulating a consultation as though the computer was the tutor and the user a pupil (Alkass and Abdou 1995).

Because of their attributes of combining factual knowledge with judgment, including the ability to handle incomplete and uncertain data, and communicate with their users in a natural language like English, such systems could have a special appeal to the construction profession. Expert systems, however, are not a total substitute for experts, but they do help to conserve expertise and are used to make expertise more widely, easily and quickly available for assistance in the decision-making process (Alkass and Abdou 1995).

On the other hand, sequential programming using Visual Basic is an efficient and readily understandable technique for calculating contractor safety performance. It is easier to construct and use than KBES.

The researcher had selected the sequential programming using Visual Basic, to develop the proposed PC-based tool, for the following reasons:

- It is more feasible for the contractor than KBES. In other words, sequential programming is easier for the contractor to use as a tool for continuous measurement of the safety performance than KBES.

- For a KBES to be efficiently used by the industrial contractor, it must be developed, validated, and refined. However, the developed KBES will most likely be a prototype system. This implies that the KBES will be used but not complete.

6.2 DESCRIPTION OF PC-BASED EVALUATION TOOL

The PC-based evaluation tool, which was developed, consists of five major parts. These parts are as follows:

6.2.1 **Project Information:** providing the project name, number, location, and the contractor's name.

6.2.2 **Influencing Factors:** providing the main factors (MFs) and their associated sub-factors (SFs) against which the contractor safety performance will be evaluated.

6.2.3 **Weights of Influencing Factors:** providing the weights of the main and sub-factors.

6.2.4 **Scores of Influencing Factors:** providing the scores of the contractor on each of the main and sub-factors.

6.2.5 **Performance Level Results:** providing the scores and the weights of the main and sub-factors used in the safety performance measurement process, in addition to the overall contractor safety performance level.

6.3 DESCRIPTION OF SUBROUTINES:

The component diagram of the proposed PC-based evaluation tool is shown in Figure 6.1. As shown, the PC-based tool consists of several subroutines. Likewise, a subroutine may consist of sub-subroutines. Each subroutine in the tool performs a specific function in the overall contractor safety performance measurement process. The tool subroutines are as follows:

6.3.1 The INIT Subroutine

The INIT (initial) subroutine is the first subroutine used in the tool. This subroutine initializes all variables and loads the main factors and their associated sub-factors along with their mean impacts and weights, which are the system-specified or built-in parameters.

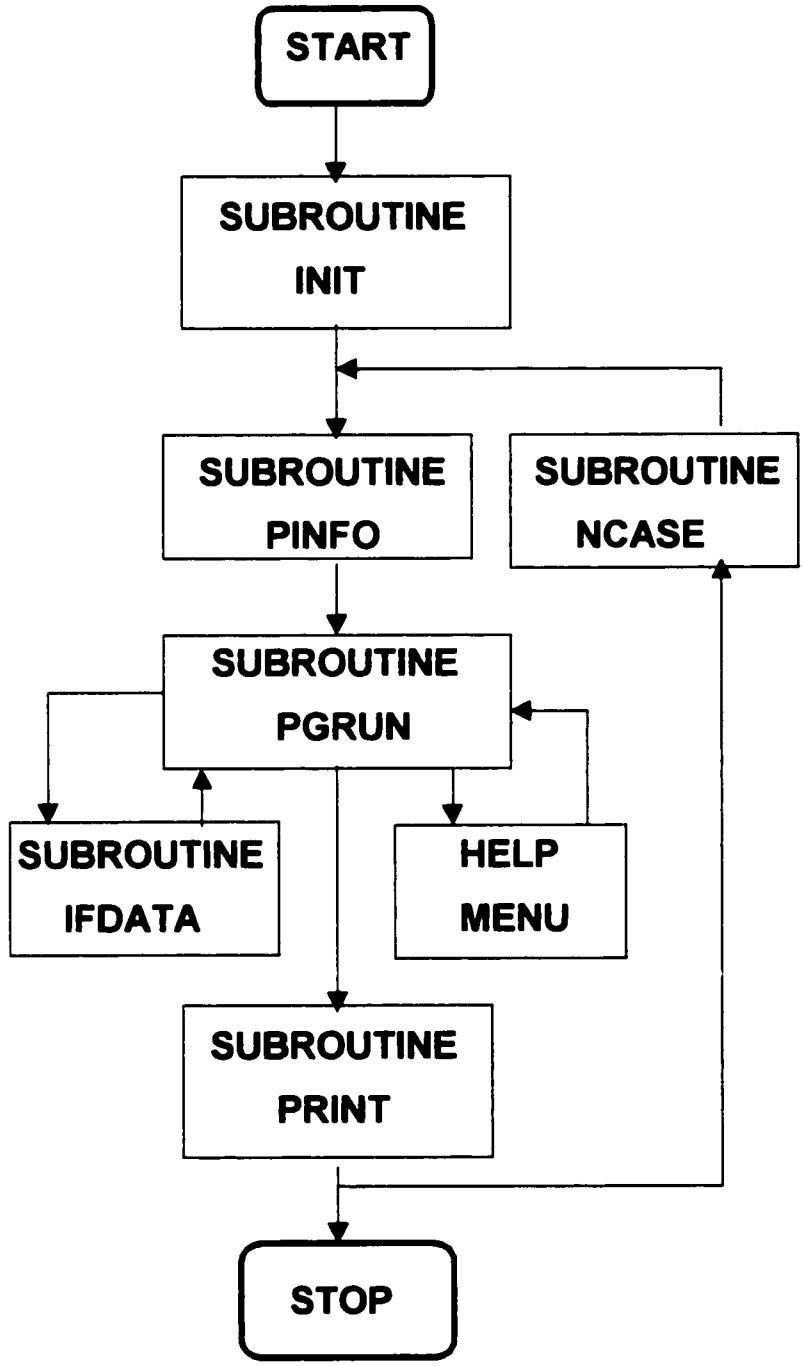

Figure 6.1: PC-Based Evaluation Tool Components Diagram

Through viewing the default values contained in the subroutine, the user will decide whether to add new parameters, delete existing parameters, or change the mean impacts of the parameters.

6.3.2 The PINFO Subroutine

The PINFO (Project Information) subroutine allows the user to input the name, number, and location of the project plus the contractor's name. In addition, the subroutine allows the user to modify the input data.

6.3.3 The IFDATA Subroutine

The IFDATA (Influencing Factors) subroutine allows the user to modify the contents of the system-specified or built-in parameters. This subroutine provides the following choices:

6.3.3.1 Accept system-specified main factors (MFs) and their associated sub-factors (SFs) along with their weights based on the survey results.

6.3.3.2 Modify the system-specified main factors (MFs) and their associated sub-factors (SFs). This includes the following choices:

A. Adding new main factors (MFs) and their associated sub-factors.

B. Adding new sub-factors (SFs) to the existing sub-factors.

C. Deleting existing main factors (MFs) and sub-factors (SFs).

6.3.3.3 The user can delete all existing main factors (MFs) and their associated sub-factors (SFs) to create his own factors. The user can create up to 20 main factors (MFs) characterized by 85 sub-factors (SFs).

The IFDATA subroutine is composed of four sub-subroutines which perform the functions specified above, namely, ADDIF (adding), DELIF (deleting), EDITIF (editing), and VUEIF (viewing).

6.3.4 The PGRUN Subroutine

Once the appropriate main factors (MFs) and associated sub-factors (SFs) and their weights are determined, the program proceeds to the next step, which is the rating score of the safety performance of the contractor. The PGRUN (Program Run) subroutine allows the user to input the score of each sub-factors (SFs). The score can be from 1, which means Poor, to 10, which means Excellent.

After entering the scores of all sub-factors and making sure that all score values are correct, the user may proceed to the next step which is the calculation of the aggregate weighted score for the contractor.

The PGRUN (Program Run) subroutine is composed of two sub-subroutines. The first, WTCALC (weight calculation) subroutine, computes the weights of the sub-factors based on the input of mean impacts provided by the user. The second, SCCALC (score calculation) sub-subroutine, multiplies the weights by the score values to come up with an aggregate weighted score, and then the safety performance of the contractor.

6.3.5 The NCAS Subroutine

The NCAS (New Case) subroutine allows the user to start a new evaluation case. This subroutine is used to initialize all variables and to load the system-supplied data. This subroutine should not be confused with the INIT subroutine, as the NCASE subroutine will initialize even the data which were modified by the IFDATA subroutine.

6.4 FACILITIES OF PC-BASED TOOL

The tool provides the user with three facilities. These facilities are:

6.4.1 The HELP Facility: The tool is provided with a help menu that includes 20 commands. Each command drives the user to a special help menu so the user can choose the most appropriate score for the specific main factors and their associated sub-factors.

6.4.2 The VIEW Facility: The user can view all input provided by him, the main factors and their associated sub-factors and the score values.

6.4.3 The PRINT Facility: The user can print the project data, the main influencing factors with their associated sub-factors, the weights, the score values the user selected, and the overall safety performance level.

6.5 HARDWARE REQUIREMENTS OF PC-BASED TOOL

The hardware requirement necessary to execute the PC-based tool, which has been developed, is an IBM personal computer or compatible, with a minimum of one disk drive. In addition, Microsoft Visual Basic for 32-bit Windows Development (version 4 or higher) is required to run the tool. The tool is entirely menu driven, and data entry, initialization of calculations and generation of reports are prompted by tool application features in order to arrive at the contractor overall safety performance level. The computer codes of this PC-based evaluation tool are shown in Appendix (D).

6.6 PROCEDURE FOR USING PC-BASED TOOL

In order to use the tool, the following steps must be performed:

6.6.1 Put the floppy disk in drive A: or B:, whichever is appropriate.

6.6.2 Start the Visual Basic Program (version - 4) and from the file menu, select the appropriate drive and then select to run the PCTOOL project.

6.6.3 The tool description screen will appear, as shown in Figure 6.2. The user may press continue to display the main menu.

6.6.4 The tool's main menu screen, shown in Figure 6.3, contains an explanation section. The user may then read and select the next operation he wishes to proceed with.

6.6.5 To proceed, the user may press Project Information and enter the required project name, number, location, and the contractor's name, as shown in Figure 6.4. After entering the project information, the user may press "Continue" to display the main menu.

6.6.6 To run the safety performance evaluation process for the selected project and contractor, using the system-specified or built-in parameters, the user may press the "Run Command" and enter the scores of each sub-factors. In doing so, the user will be given four impact options (Excellent = 10, Good = 7, Fair = 5, and Poor = 1) for each sub-factor. According to safety experts (reference 12), these options are well known criteria normally used for safety and loss prevention evaluation. Figure 6.5 represents a typical evaluation screen for one of the main factors "Site Planning and Housekeeping".

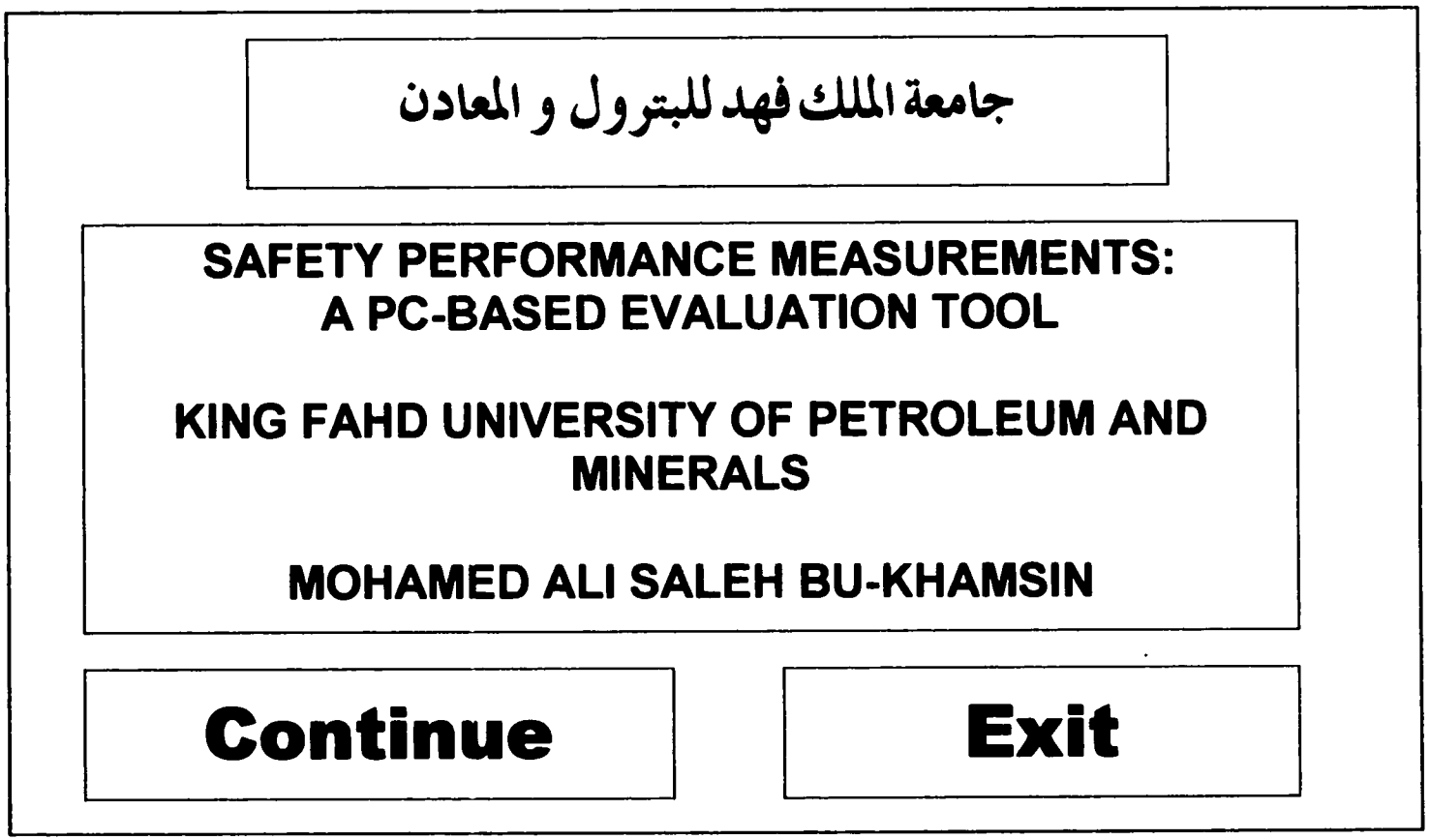

Figure 6.2: PC-Based Evaluation Tool Description Screen

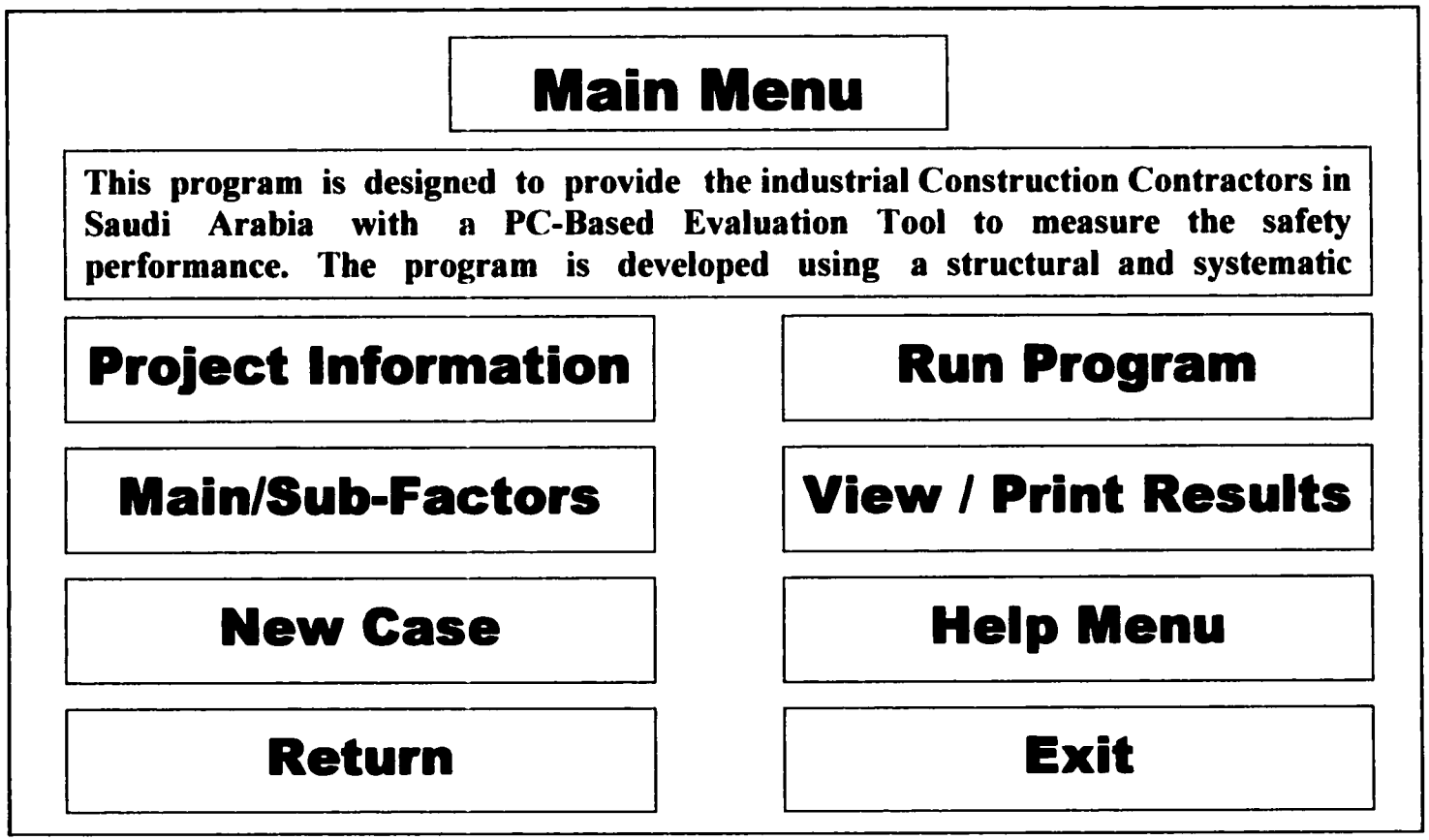

Figure 6.3: PC-Based Evaluation Tool Main Menu Screen

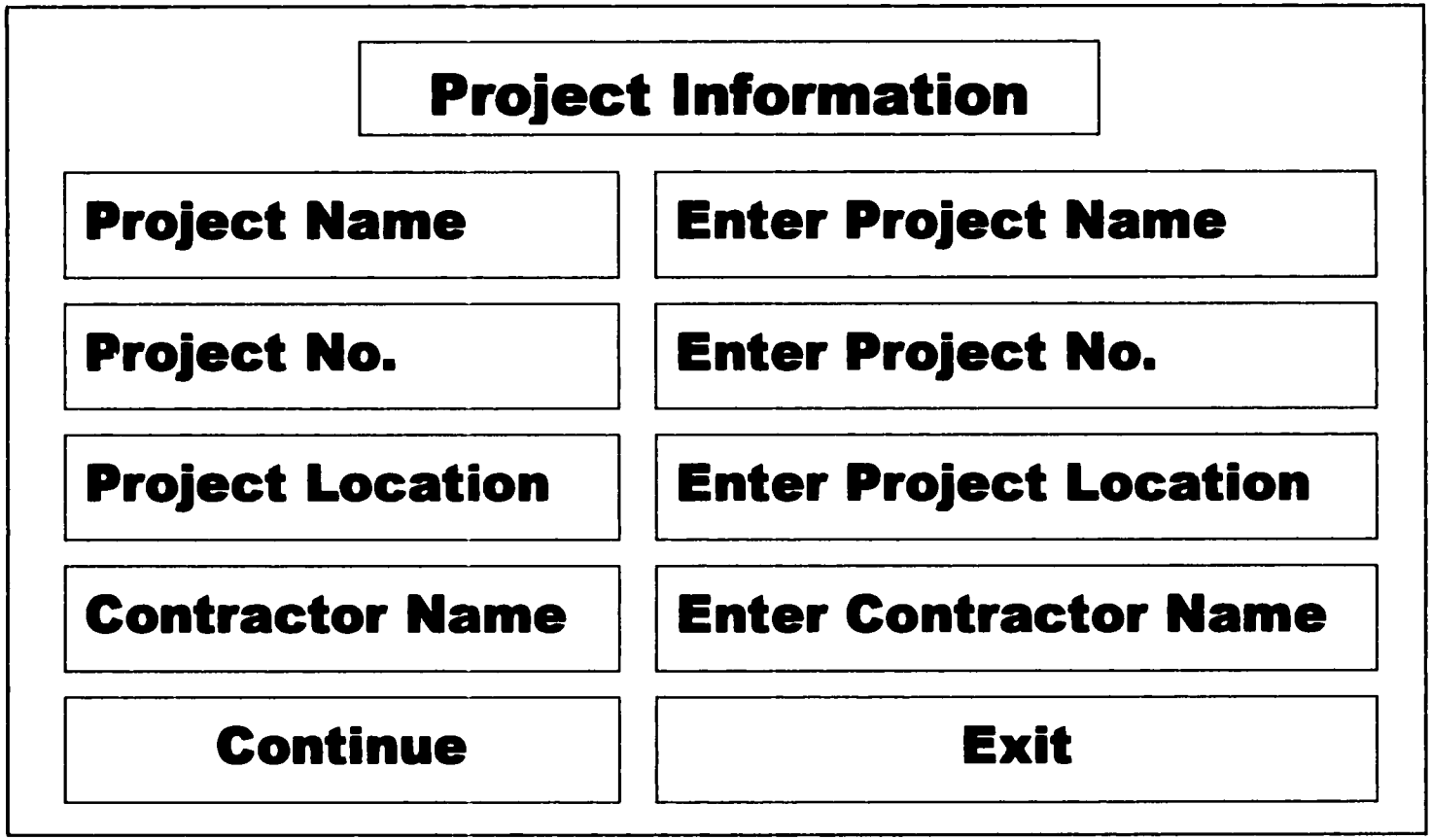

Figure 6.4: Project Information Screen

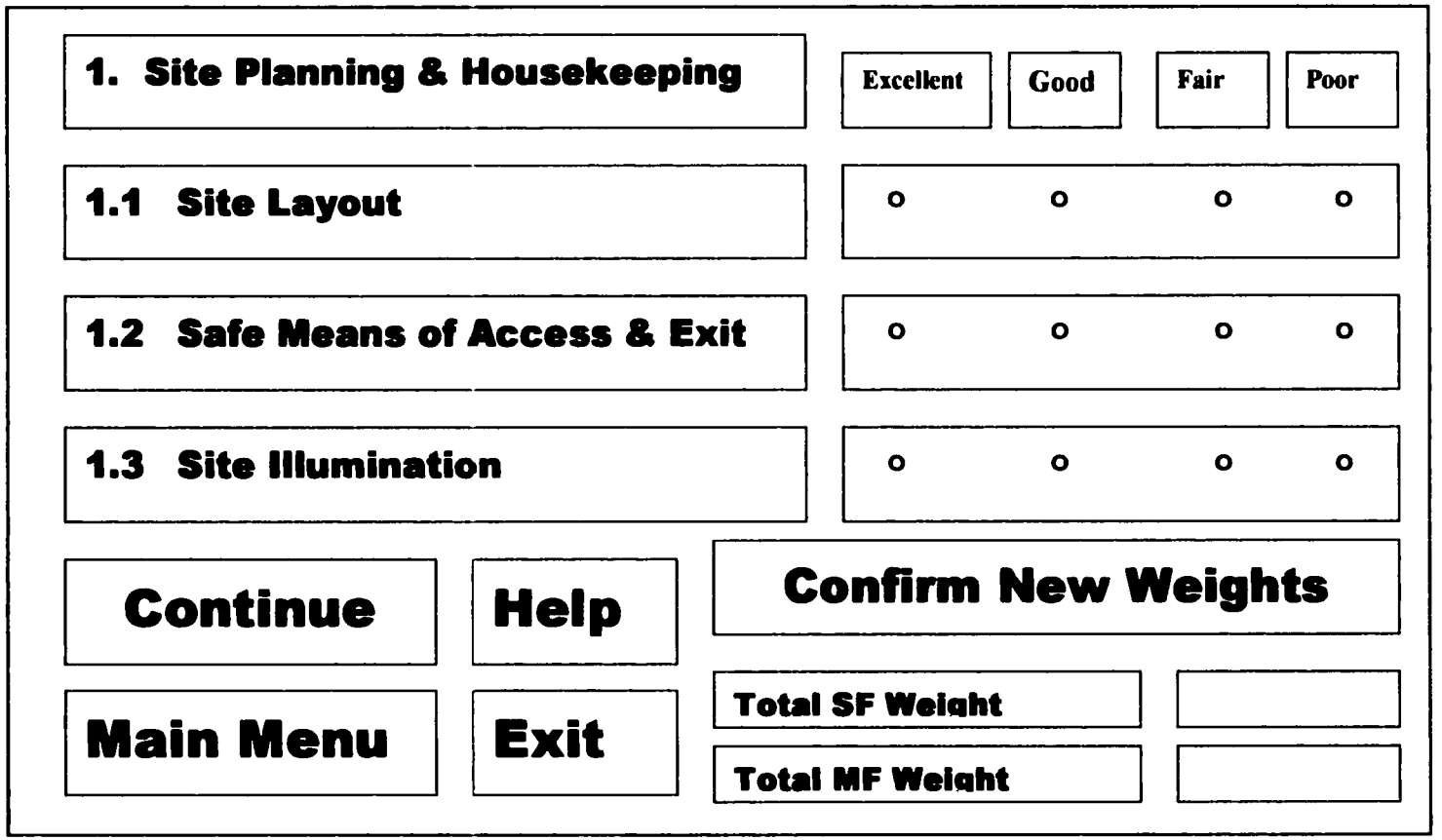

Figure 6.5: Typical Main Factor Evaluation Screen

6.6.7 To get help in selecting the appropriate scores of any of the twenty main factors and their associated sub-factors, the user may select the help option displayed on the main menu. In doing so, the system will display a help menu, as shown in Figure 6.6, which provides a list of all the 20 main factors for the user to select. The user may press the command of the required factor and read its help screen. Figure 6.7 represents a typical help screen for one main factor, namely, Emergency / Disaster Planning and Preparation.

6.6.8 To review and/or edit the main factors available and their associated sub-factors, the user may press the Influencing Factors command. In doing so, the system will display each of the five main factors with their weights on one screen, as shown in Figure 6.8. The user may accept or change the existing factors description and/or their weights. In addition, the system will provide the user with the option to review/edit the sub-factors with their default weights, as shown in Figure 6.9.

6.6.9 To view and /or print the list of the main and sub-factors, their weights, the scores entered, and the calculated overall safety performance level, the user may select the view / print results menu, as shown in Figure 6.10. In doing so, the user will have the option to print the above data.

6.6.10 To start a new case, the user may press New Case command and start the process again.

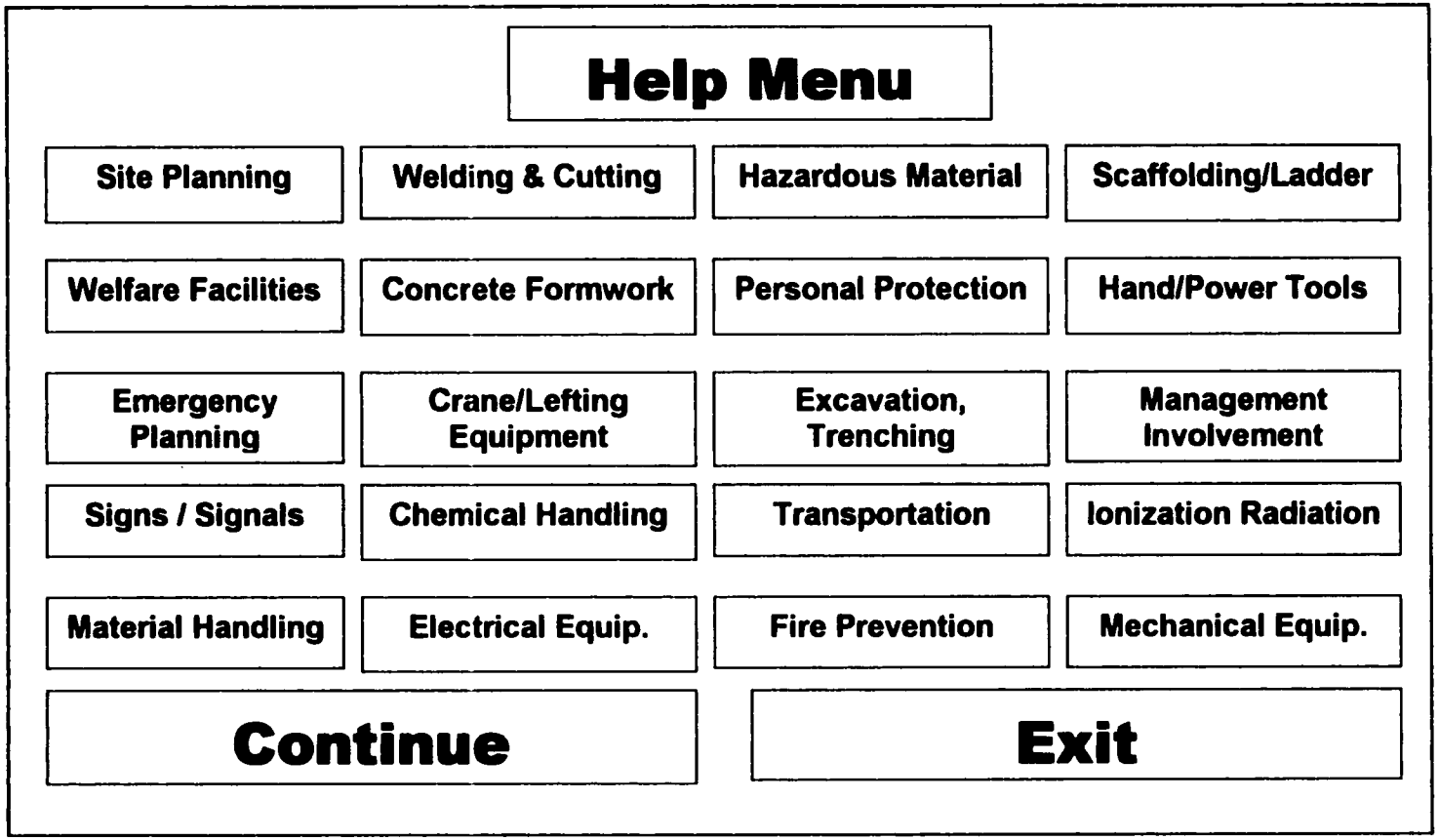

Figure 6.6: PC-Based Tool Main Help Menu

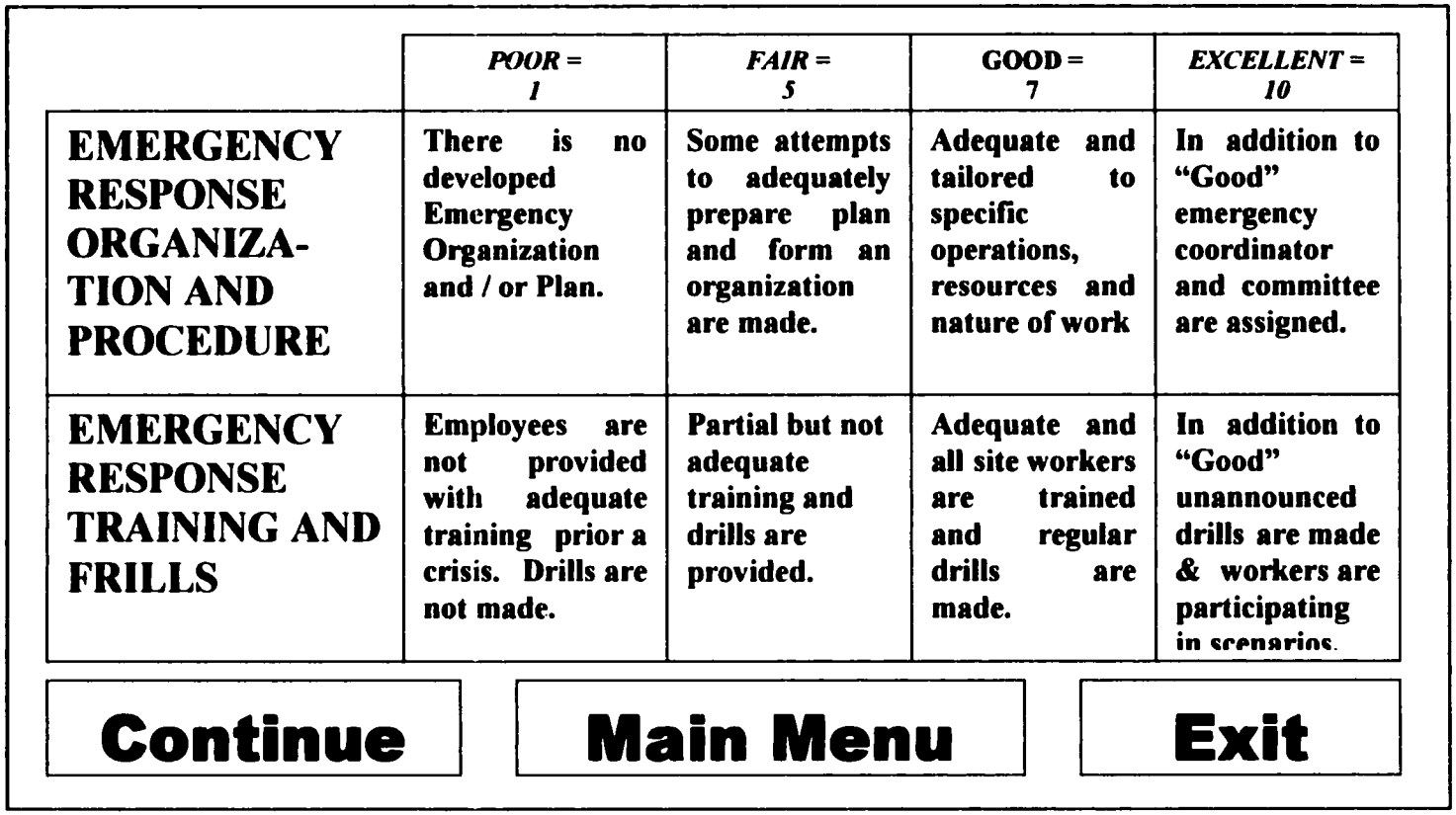

Figure 6.7: Typical Main Factor Help Screen

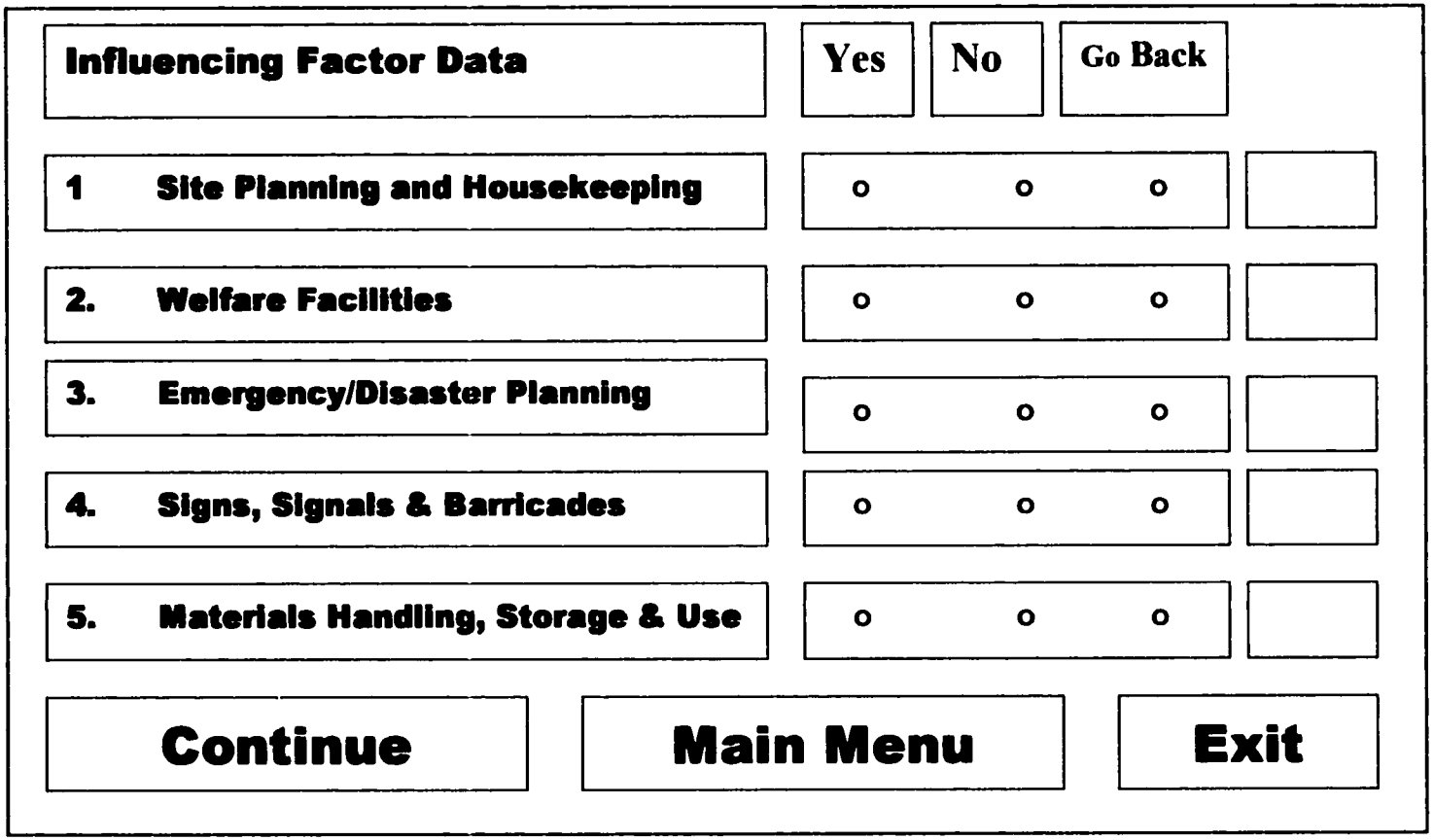

Figure 6.8: Main Factors Edit Screen

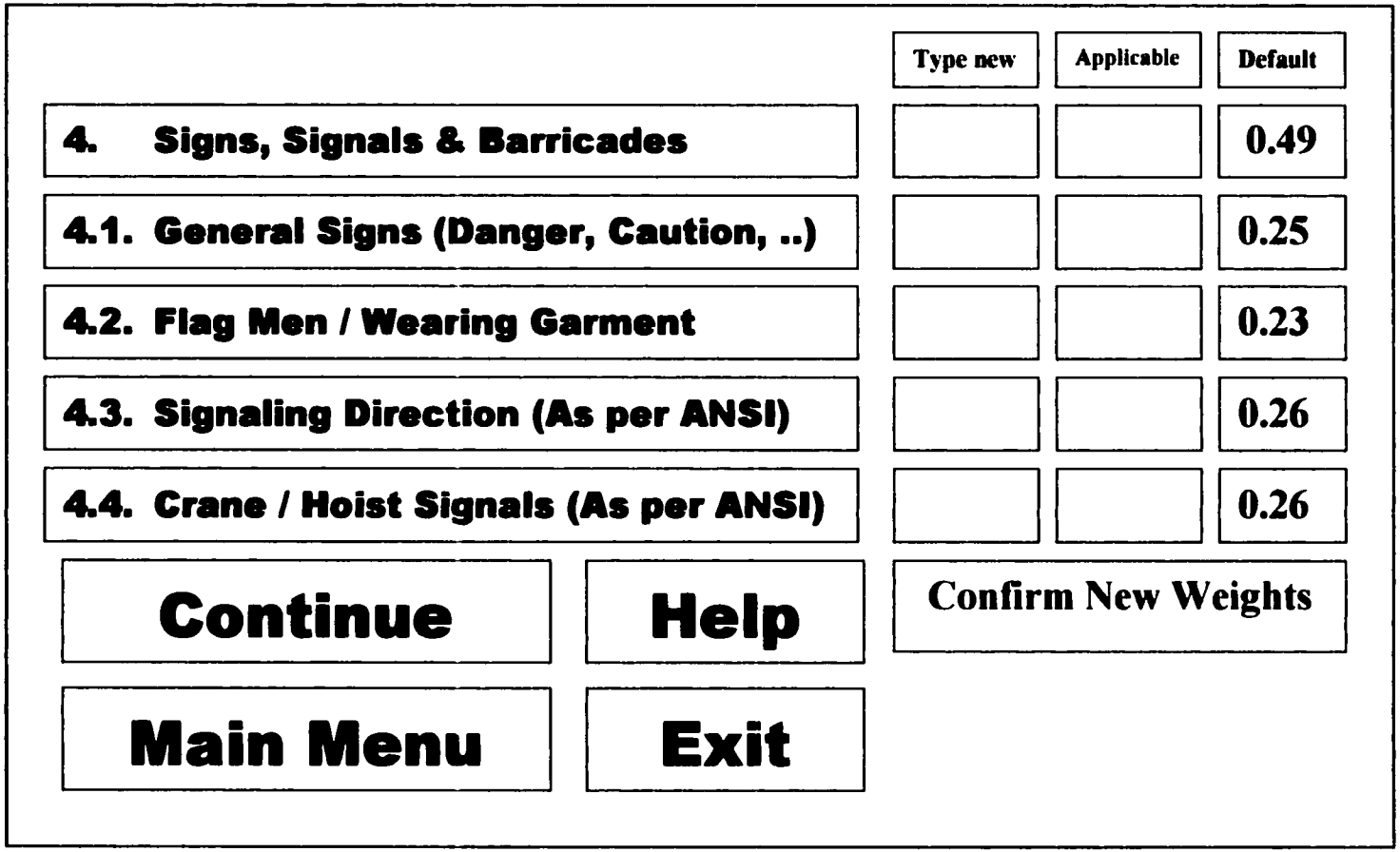

Figure 6.9: Typical Factor Review / Edit Screen

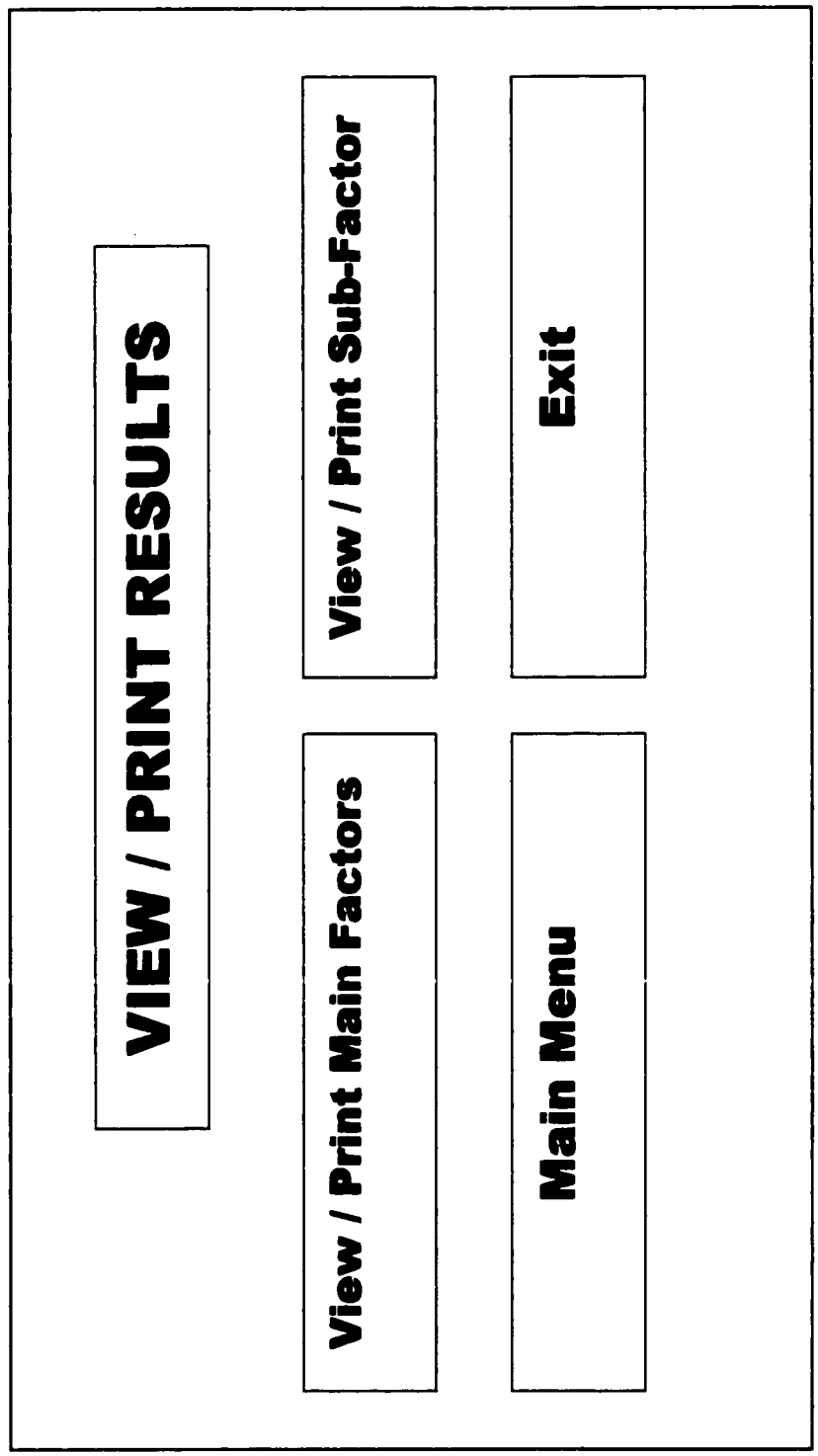

Figure 6.10: PC-Based Tool View / Print Results Menu

6.6.11 To exit the program at any time, the user may press the Exit command available on every screen in the tool.

6.7 EXAMPLES OF APPLICATION

Two examples which demonstrate the capabilities of the PC-based evaluation tool can be found in Figure 6.11 and Figure 6.12. The details of these examples are provided below:

The first example is based on the system-supplied data. This means that the system-specified Main Factors (MFs) and their associated Sub-Factors (SFs) were selected to be the criteria upon which the contractor safety performance will be evaluated.

In addition, no changes in the system specified mean impacts were made. As shown in Figure 6.11, the safety performance of the contractor (entitled Mohammed) was 100 % which corresponds to "Excellent Performance".

The second example contained in Figure 6.12 is based on some modifications on the system-supplied Main Factors (MFs) and their associated Sub-Factors (SFs). These modifications include:

Project Name	USING SYSTEM-SUPPLIED DATA
Project No.	EXAMPLE
Project Location	KFUPM
Contractor Name	MOHAMMED

	MAIN FACTORS	RESULTS
1.	Site Planning and Housekeeping	3.9
2.	Welfare Facilities	4.2
3.	Emergency / Disaster Planning and Preparation	6.0
4.	Signs, Signals and Barricades	5.0
5.	Materials Handling, Storage and Use	4.3
6.	Welding and Cutting	4.7
7.	Concrete and Concrete Formworks	4.6
8.	Crane and Lifting Equipment	5.6
9.	Chemical Handling	4.9
10.	Electrical Equipment	5.1
11.	Handling, Transportation / Disposal of Hazardous	4.6
12.	Personal Protective Equipment	6.0
13.	Fire Prevention	5.2
14.	Transportation	4.8
15.	Excavation / Trenching and Shoring	5.0
16.	Scaffolding and Ladders	5.6
17.	Hand and Power Tools	3.8
18.	Mechanical Equipment	5.0
19.	Ionization Radiation	5.7
20.	Management Involvement	6.0

SAFETY PERFORMANCE = 100 EXCELLENT PERFORMANCE

Figure 6.11: Application Of System-Supplied Data

Project Name	**USING SYSTEM-SUPPLIED DATA**
Project No.	**EXAMPLE**
Project Location	**KFUPM**
Contractor Name	**MOHAMMED**

		MAIN FACTORS	WEIGHT	SCORE
1.0		**Site Planning and Housekeeping**	**3.9**	
	1.1	Site Layout	0.38	10
	1.2	Safe Means of Access and Exits	0.35	10
	1.3	Site Illumination	0.27	10
2.0		**Welfare Facilities**	**4.2**	
	2.1	First Aid Facilities	0.25	10
	2.2	Food / Drinking Water Facilities	0.16	10
	2.3	Ambulance	0.24	10
	2.4	Showers / Eyewash Fountains	0.21	10
	2.5	Smoking Area / Toilet / Wash Facilities	0.14	10
3.0		**Emergency / Disaster Planning and Preparation**	**6.0**	
	3.1	Emergency Response Organization / Procedures	0.5	10
	3.2	Emergency Response Training and Drills	0.5	10
4.0		**Signs, Signals and Barricades**	**5.0**	
	4.1	General Signs (Danger, Caution, ...)	0.25	10
	4.2	Flag Men / Wearing Garment	0.23	10
	4.3	Signaling Direction (As per ANSI)	0.26	10
	4.4	Crane / Hoist Signals (As per ANSI)	0.26	10
5.0		**Materials Handling, Storage and Use**	**4.3**	
	5.1	Aisles and Driveways	0.22	10
	5.2	Fence and Access Gates	0.21	10
	5.3	Arrangement of Materials	0.23	10
	5.4	Fire Protection Equipment	0.34	10
6.0		**Welding and Cutting**	**4.7**	
	6.1	Handling of Cylinders	0.17	10
	6.2	Daily Inspection of Equipment	0.18	10
	6.3	Adequate Ventilation	0.18	10
	6.4	Grounding and Fire Guard	0.24	10
	6.5	Personal Protection Equipment	0.23	10
7.0		**Concrete and Concrete Formworks**	**4.6**	
	7.1	Work Platform / Guardrails	0.17	10
	7.2	Grounded Electrical Vibrator	0.21	10
	7.3	Experienced Workmanship	0.22	10
	7.4	Shoring Sketches / Drawings on Site	0.18	10
	7.5	Forms / Adequate Shoring of Supports	0.22	10

Figure 6.11: Application Of System-Supplied Data

		MAIN FACTORS	WEIGHT	SCORE
8.0		**Crane and Lifting Equipment**	**5.6**	
	8.1	Lift Plan on Site	0.20	10
	8.2	Licensed Operators	0.21	10
	8.3	Safe Load Indicator / Inspection Stickers	0.20	10
	8.4	Safety Latches (Hooks)	0.20	10
	8.5	Rigger Training	0.19	10
9.0		**Chemical Handling**	**4.9**	
	9.1	Proper Identification / Warning Signs	0.33	10
	9.2	Adequate Storage / Usage	0.30	10
	9.3	Emergency Treatment	0.37	10
10.0		**Electrical Equipment**	**5.1**	
	10.1	Temporary Installation Precautions	0.23	10
	10.2	Lockout / Tagging / Warning Signs	**0.26**	10
	10.3	Initial Inspection / Tests	0.24	10
	10.4	Testing of Grounds	0.28	10
11.0		**handling Transportation / Disposal of Hazardous Materials**	**4.6**	
	11.1	Hazard Identification Plan	0.41	10
	11.2	Waste Management Plan	0.33	10
	11.3	disposal Sites / Disposal Documents	0.26	10
12.0		**Personal Protective Equipment**	**6.0**	
	12.1	Head / Eye / Face / Hand / Foot Protection	0.34	10
	12.2	Fall Restraining / Arresting Devices	0.33	10
	12.3	Breathing Apparatus	0.33	10
13.0		**Fire Prevention**	**5.2**	
	13.1	Adequate Fire Extinguisher / Locations	0.23	10
	13.2	Control of Ignition / Fire Watches	0.19	10
	13.3	Storage of Flammable / Combustible	0.21	10
	13.4	Fire Extinguishers Training / Drills	0.20	10
	13.5	Fire Extinguisher Regular Maintenance	0.17	10
14.0		**Transportation**	**4.8**	
	14.1	Vehicle Condition / Regular Maintenance	0.19	10
	14.2	Passenger Seating / Seat belt Enforcement	0.19	10
	14.3	Motor Vehicle Regulations	0.19	10
	14.4	First Aid Equipment / Fire Extinguisher	0.22	10
	14.5	Driver Training	0.21	10

Figure 6.11: Application Of System-Supplied Data

		MAIN FACTORS	WEIGHT	SCORE
15.0		**Excavation / Trenching and Shoring**	**5.0**	
	15.1	Cave-in Protection (Shoring / Trench)	0.39	10
	15.2	Excavation Plan on Site	0.26	10
	15.3	Access and Exits / Walkways	0.35	10
16.0		**Scaffolding and Ladders**	**5.6**	
	16.1	Adequate Components and Fittings	0.25	10
	16.2	Experienced Workmanship	0.25	10
	16.3	Scaffold Access and Proper Loading	0.24	10
	16.4	Adequate Scaffolding Stability	0.26	10
17.0		**Hand and Power Tools**	**3.8**	
	17.1	Overall Condition / Daily Inspection	0.37	10
	17.2	Individual Tools Precautions	**0.31**	10
	17.3	Selection / Training	0.32	10
18.0		**Mechanical Equipment**	**5.0**	
	18.1	Qualified and Certified Operators	0.35	10
	18.2	Machinery Guards / Safety Protection	0.36	10
	18.3	Regular Inspection / Strict Maintenance	0.29	10
19.0		**Ionization Radiation**	**5.7**	
	19.1	Health Hazard Identification	0.21	10
	19.2	Protection Against Radiation	0.21	10
	19.3	Adequate Training / Safe Handling	0.20	10
	19.4	Intensive Inspection Each Shift	0.19	10
	19.5	Shipping / Transport / Storage areas	0.19	10
20.0		**Management Involvement**	**6.0**	
	20.1	Initiate / Administer Company Safety Policy	0.10	10
	20.2	Know / Adhere to Workmen Regulations	0.09	10
	20.3	Ensure Qualified / Trained Supervisors	0.09	10
	20.4	Consider Safety at Tendering / Planning	0.09	10
	20.5	Institute / Adhere to Loss Prevention Program	0.09	10
	20.6	Fix Accountability of Safety	0.09	10
	20.7	Set a Personal Example	0.09	10
	20.8	Prepare Hazard Identification Plan	0.09	10
	20.9	Prepare Emergency Evacuation Procedures	0.09	10
	20.10	Communicate / Share Safety Activities	0.09	10
	20.11	Safety Motivation (Posters, Incentives, ...)	0.09	10
		SAFETY PERFORMANCE = 100 "EXCELLENT PERFORMANCE"		

Figure 6.11: Application Of System-Supplied Data

Project Name	USING MODIFICATION SYSTEM-SUPPLIED DATA
Project No.	EXAMPLE
Project Location	KFUPM
Contractor Name	MOHAMMED

	MAIN FACTORS	RESULTS
1.	Site Planning and Housekeeping	3.9
2.	Welfare Facilities	4.2
3.	Emergency / Disaster Planning and Preparation	6.0
4.	Signs, Signals and Barricades	5.0
5.	Materials Handling, Storage and Use	4.5
6.	Welding and Cutting	N / A
7.	Concrete and Concrete Formworks	N / A
8.	Crane and Lifting Equipment	1.7
9.	Chemical Handling	3.6
10.	Electrical Equipment	5.1
11.	Handling, Transportation / Disposal of Hazardous	3.5
12.	Personal Protective Equipment	6.0
13.	Fire Prevention	5.2
14.	Transportation	4.8
15.	Excavation / Trenching and Shoring	3.7
16.	Scaffolding and Ladders	5.6
17.	Hand and Power Tools	3.8
18.	Mechanical Equipment	5.0
19.	Ionization Radiation	5.7
20.	Management Involvement	6.0

SAFETY PERFORMANCE = 83.3 "GOOD PERFORMANCE"

Figure 6.12: Application Of Modification System-Supplied Data

Project Name	**USING MODIFICATION SYSTEM-SUPPLIED DATA**
Project No.	**EXAMPLE**
Project Location	**KFUPM**
Contractor Name	**MOHAMMED**

		MAIN FACTORS	WEIGHT	SCORE
1.0		**Safety on the Construction Site**	**3.9**	
	1.1	Last Five Years' Accidents	0.60	10
	1.2	Severity of Accidents	0.40	10
2.0		**Welfare Facilities**	**4.2**	
	2.1	First Aid Facilities	0.25	10
	2.2	Food / Drinking Water Facilities	0.16	10
	2.3	Ambulance	0.24	10
	2.4	Showers / Eyewash Fountains	0.21	10
	2.5	Smoking Area / Toilet / Wash Facilities	0.14	10
3.0		**Emergency / Disaster Planning and Preparation**	**6.0**	
	3.1	Emergency Response Organization / Procedures	0.5	10
	3.2	Emergency Response Training and Drills	0.5	10
4.0		**Signs, Signals and Barricades**	**5.0**	
	4.1	General Signs (Danger, Caution, ...)	0.25	10
	4.2	Flag Men / Wearing Garment	0.23	10
	4.3	Signaling Direction (As per ANSI)	0.26	10
	4.4	Crane / Hoist Signals (As per ANSI)	0.26	10
5.0		**Materials Handling, Storage and Use**	**4.5**	
	5.1	Aisles and Driveways	0.22	10
	5.2	Fence and Access Gates	0.21	10
	5.3	Arrangement of Materials	0.23	10
	5.4	Guard Service	0.34	10
6.0		**Welding and Cutting**	**4.7**	
7.0		**Concrete and Concrete Formworks**	**4.6**	

Figure 6.12: Application Of Modification System-Supplied Data

		MAIN FACTORS	WEIGHT	SCORE
8.0		**Crane and Lifting Equipment**	**1.7**	
	8.1	Lift Plan on Site	0.20	7
	8.2	Licensed Operators	0.21	5
	8.3	Safe Load Indicator / Inspection Stickers	0.20	1
	8.4	Safety Latches (Hooks)	0.20	1
	8.5	Rigger Training	0.19	1
9.0		**Chemical Handling**	**3.6**	
	9.1	Proper Identification / Warning Signs	0.33	10
	9.2	Adequate Storage / Usage	0.30	7
	9.3	Emergency Treatment	0.37	5
10.0		**Electrical Equipment**	**5.1**	
	10.1	Temporary Installation Precautions	0.23	10
	10.2	Lockout / Tagging / Warning Signs	**0.25**	10
	10.3	Initial Inspection / Tests	0.24	10
	10.4	Testing of Grounds	0.28	10
11.0		**Disposal of Hazardous Materials**	**3.5**	
	11.1	Hazard Identification Plan	0.41	10
	11.2	Waste Management Plan	0.33	7
	11.3	disposal Sites / Disposal Documents	0.26	5
12.0		**Personal Protective Equipment**	**6.0**	
	12.1	Head / Eye / Face / Hand / Foot Protection	0.34	10
	12.2	Fall Restraining / Arresting Devices	0.33	10
	12.3	Breathing Apparatus	0.33	10
13.0		**Fire Prevention**	**5.2**	
	13.1	Adequate Fire Extinguisher / Locations	0.23	10
	13.2	Control of Ignition / Fire Watches	0.19	10
	13.3	Storage of Flammable / Combustible	0.21	10
	13.4	Fire Extinguishers Training / Drills	0.20	10
	13.5	Fire Extinguisher Regular Maintenance	0.17	10
14.0		**Transportation**	**4.8**	
	14.1	Vehicle Condition / Regular Maintenance	0.19	10
	14.2	Passenger Seating / Seat belt Enforcement	0.19	10
	14.3	Motor Vehicle Regulations	0.19	10
	14.4	First Aid Equipment / Fire Extinguisher	0.22	10
	14.5	Driver Training	0.21	10

Figure 6.12: Application Of Modification System-Supplied Data

		MAIN FACTORS	WEIGHT	SCORE
15.0		**Excavation / Trenching and Shoring**	**3.7**	
	15.1	Cave-in Protection (Shoring / Trench)	0.39	10
	15.2	Excavation Plan on Site	0.26	7
	15.3	Access and Exits / Walkways	0.35	5
16.0		**Scaffolding and Ladders**	**5.6**	
	16.1	Adequate Components and Fittings	0.25	10
	16.2	Experienced Workmanship	0.25	10
	16.3	Scaffold Access and Proper Loading	0.24	10
	16.4	Adequate Scaffolding Stability	0.26	10
17.0		**Hand and Power Tools**	**3.8**	
	17.1	Overall Condition / Daily Inspection	0.37	10
	17.2	Individual Tools Precautions	**0.31**	10
	17.3	Selection / Training	0.32	10
18.0		**Mechanical Equipment**	**5.0**	
	18.1	Qualified and Certified Operators	0.35	10
	18.2	Machinery Guards / Safety Protection	0.36	10
	18.3	Regular Inspection / Strict Maintenance	0.29	10
19.0		**Ionization Radiation**	**5.7**	
	19.1	Health Hazard Identification	0.21	10
	19.2	Protection Against Radiation	0.21	10
	19.3	Adequate Training / Safe Handling	0.20	10
	19.4	Intensive Inspection Each Shift	0.19	10
	19.5	Shipping / Transport / Storage areas	0.19	10
20.0		**Management Involvement**	**6.0**	
	20.1	Initiate / Administer Company Safety Policy	0.10	10
	20.2	Know / Adhere to Workmen Regulations	0.09	10
	20.3	Ensure Qualified / Trained Supervisors	0.09	10
	20.4	Consider Safety at Tendering / Planning	0.09	10
	20.5	Institute / Adhere to Loss Prevention Program	0.09	10
	20.6	Fix Accountability of Safety	0.09	10
	20.7	Set a Personal Example	0.09	10
	20.8	Prepare Hazard Identification Plan	0.09	7
	20.9	Prepare Emergency Evacuation Procedures	0.09	5
	20.10	Communicate / Share Safety Activities	0.09	1
	20.11	Safety Motivation (Posters, Incentives, ...)	0.09	10
	SAFETY PERFORMANCE		= 83.3 "GOOD PERFORMANCE"	

Figure 6.12: Application Of Modification System-Supplied Data

6.7.1 Deleting one existing Main Factor namely, Site Planning & Housekeeping.

6.7.2 Adding one new Main Factor, namely, Safety on the Construction Site, with a weight of 3.9, and adding two Sub-Factors under this MF, namely, Accidents over Last Five years, and Severity of Accidents, with weights of 0.60 and 0.40, respectively.

6.7.3 Changing the weight of the MF, Material Handling, Storage and Use from 4.3 to 4.5.

6.7.4 Replacing one sub-factor named "Fire Protection Equipment" by new sub-factor "Guard Service" to the main factor " Material Handling, Storage and Use" with a weight of 0.34.

6.7.5 Excluding two main factors, namely, Welding and Cutting Factor, and Concrete and Concrete Formwork factor. This assumes that these two factors are not applicable to the contractor in the example.

Again, the same contractor, named Mohammed, was used to demonstrate the above example. As shown in (Fig. 6.12), the safety performance of the contractor was 83.3% which corresponds to "Good Performance".

6.8 PC-BASED TOOL VALIDATION

6.8.1 Participants Feedback

The PC-based tool passed through several stages until it came to its final form. At each new stage, a new concept or idea was generated. Most of these were made while conducting interviews with safety officials and with participating contractors' safety personnel. The final form of the tool, as a result of the feedback received from the above mentioned interviews, was re-evaluated by the contractor as the end user of the tool. The contractors expressed their satisfaction regarding the tool flexibility and applicability.

6.8.2 Numeral Calculation

Numeral calculation was used to validate the reliability of the tool, to ensure that the PC-based tool will produce accurate results. This was done for the following two cases:

CASE 1: Calculating the safety performance using the system-supplied data and assuming all the main factors are applicable to contractor and assigning excellent evaluation (score = 10) to each factor.

CASE 2: Calculating the safety performance using the following modified data:

A. All the non-critical factors are assumed to be not applicable to the contractor.

B. The contractor will be rated fair (score = 7) for each of the remaining critical factors.

By applying equation 4 and 5, as shown in chapter four page 81 & 82 respectively , and using the total weights of all the factors = 100, the weights of the critical factors = 50.5, the weights of the non-critical factors = 49.5, the aggregate weight rating for the contractor is calculated. Then, the safety performance is calculated as follows (Cooper and Steinberg 1974):

Safety Performance = $AWS^* [W_{max} /(W_{max} - W_{na})]$ (5)

Where: AWS = aggregate weight rating for the contractor

W_{max} = maximum attainable weight

W_{na} = weight of non-appreciable factors

Applying the above equation gives the following results for Case 1:

Safety Performance = $AWS^* [W_{max} /(W_{max} - W_{na})]$ (5)

Safety Performance = $100 * [100 / (100 - 0)] = 100$

Safety Performance = 100%

Similarly for Case 2: = $AWS^* [W_{max} /(W_{max} - W_{na})]$ (5)

Safety Performance = $35.35 * [100 / (100 - 49.5)] = 70$

Safety Performance = 70%

This is exactly in agreement with the results of the PC-based tool.

CHAPTER SEVEN

CONCLUSIONS AND RECOMMENDATIONS

7.1 SUMMARY OF STUDY

7.1.1 A PC-based evaluation tool for determining the industrial construction contractor safety performance has been developed. The tool was developed over predetermined procedures. First, an extensive literature review was conducted to identify the major factors which directly affect the safety performance of construction contractors. Then, a questionnaire was developed and distributed to gather data regarding the impact that the influencing factors have on the contractor's safety performance. The questionnaire incorporated 20 main factors and their associated 85 sub-factors. Twenty five (25) industrial construction contractors participated in the study, representing 89% of the surveyed contractors.

7.1.2 The data collected from the questionnaire was used to calculate the mean impact and the weights of all factors and sub-factors using a Microsoft Excel worksheet. The weights were utilized to develop the PC-based evaluation

tool. The main and sub-factors and their weights built in the tool are those which are based on the overall mean impact of the whole surveyed sample.

7.1.3 The PC-based tool thus developed provides the user with the facility to change the weights of the main and sub-factors, add new factors, and delete existing factors. In fact, by the provision of this facility, the user is able to create his own influencing factors and / or sub-factors.

7.1.4 The main benefit of this computerized tool is that it provides the contractor with an easy to use tool to plan safety measures, integrate safety concerns in the construction process, and monitor safety performance during construction. In addition, this tool will reduce the amount of human effort and time required to perform this process.

7.2 SUMMARY OF RESULTS

A summary of the results revealed in this study is provided below:

7.2.1 From the extensive literature review and the interviews with the contractor's key safety personnel and official safety experts, a total of 20 main factors and 85 sub-factors were identified as the major factors influencing the safety performance of construction contractors.

7.2.2 From the results achieved it is concluded that Management Involvement, Personal Protective Equipment, Emergency / Disaster Planning & Preparation, Ionization Radiation, Scaffolding & Ladders, Crane & Lifting Equipment, Fire Prevention, Electrical Equipment, Excavation, Trenching & Shoring, and Mechanical Equipment are the most important main factors influencing the industrial construction contractor safety performance. The total weight of these factors is 55.2%.

7.2.3 All the participants showed consensus agreement on the importance of three main factors, namely, Management Involvement, Personal Protective Equipment, and Emergency/Disaster Planning and Preparation. This can be revealed by the highest impact and weights (6.0) of each of the three factors. This emphasizes the fact that Management Involvement is vital for any successful safety program. In addition to Personal Protective Equipment and Emergency / Disaster Planning & Preparation, Management Involvement is extremely important for any industrial construction contractor and for each construction project.

7.2.4 The industrial construction contractors in the Eastern Province of Saudi Arabia do not have a systematic approach to measure the safety performance; rather they depend on monitoring after-the-fact safety performance indices (i.e. injury frequency rate, severity rates, and incidence rates).

7.2.5 The PC-based evaluation tool which has been developed provides a systematic, structured approach to the evaluation of contractor safety performance against the predetermined main and sub-factors and their weights. It is flexible as it will allow the user to change the weights of the main factors, add/delete factors or sub-factors in place of any of the existing main and/or sub-factors. In addition, the tool provides a help option which gives the user step-by-step directions to complete the performance measurement process.

7.3 RECOMMENDATIONS

7.3.1 Recommendations

As a result of this research, the following recommendations can be made:

7.3.1.1 All industrial construction contractors in the Eastern Province of Saudi Arabia are encouraged to consider the factors revealed by this thesis to have a major influence on contractor safety performance whenever they need to measure the safety performance level.

7.3.1.2 All industrial construction contractors in the Eastern Province of Saudi Arabia are advised to use the PC-based evaluation tool developed in thesis in the

regular safety performance measurement process. In addition, they are also advised to use the tool three times throughout the life cycle of each project (i.e. at the beginning, after 50 % completion, and near the end of the project) to determine the safety performance level and to take the necessary proactive actions to control any deficiencies in the safety program. This will provide effective control of the progress of the safety program.

7.3.1.3 Since construction projects are different in design, layout, materials used, construction methods, time, crews, weather, and management, contractors are strongly advised to use the tool for each project individually.

7.3.1.4 Although the PC-based evaluation tool in this thesis is developed to be applied to Eastern Province industrial construction contractors, this tool can be applied to industrial construction contractors in other areas of Saudi Arabia or in any other country.

7.3.2 Suggestions for Further Studies

7.3.2.1 Although the most important factors influencing safety performance were discussed in this thesis, the relationship between the cost of establishing and administrating a construction safety program, which include all the factors

identified, vs. the project cost, was not discussed. For this reason, it is recommended that a study be done to investigate such a relationship.

7.3.2.2 Additional research on the factors influencing contractor safety performance from the owner's perspective should be conducted. The results of such research should be compared with the results of this thesis. Such research will provide the owner with a means to review a contractor's safety plan and monitor performance during construction.

7.3.2.3 Research on the development of a Knowledge Based Expert System (KBES) to measure construction contractor safety performance should be considered. An expert system that incorporates the expertise of a safety specialist to provide advice on contractor safety performance improvement is highly recommended. Such a system will help to conserve expertise and make it more widely, easily and quickly available for assistance in this extremely important process (i.e. safety performance evaluation).

7.3.2.4 Research on the effect of high technology (such as radio, remote control, and robots) which may improve construction contractor safety should be considered.

7.3.2.5 A similar research on safety performance measurement of other types of construction contractors (i.e. public contractors) may be considered.

7.3.2.6 Additional research on the relationship between the size of the safety crew (i.e. full-time safety representatives) and the safety performance level should be considered. Such research should consider the size of the company and the nature of its activities.

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APPENDICES

APPENDIX – A

SAMPLE OF QUESTIONNAIRE USED FOR SURVEY

February 14, 1998

Dear Manager,
(Company Name)
(Company Address)

The purpose of this letter is to kindly invite you to participate in a study survey regarding the safety performance measurement of Industrial Construction Contractors in the Eastern Province of Saudi Arabia.

The objective of the study is to identify and analyze the factors which influence the safety performance of industrial construction contractors, and to develop a PC-Based Evaluation Tool to evaluate and monitor contractor safety performance.

The results of this study can be a great help to your organization by providing you with a valid and reliable tool to measure the safety performance. The results can give you a meaningful method to continuously examine the accident situations at the non injurious state where the potential for loss is involved but where the loss has not yet actually occurred.

Please let your Safety or Loss Prevention Personnel provide the required information requested in the enclosed questionnaire. The information provided by you will be used only for the purpose of the study without mentioning the name of the organization. We realize that there are numerous demands on your time. However your involvement is a vital requisite for this study. We will be highly grateful to you if you could return the completed questionnaire on or before the 15th of March 1998 at any one of the addresses below.

We highly recommend that you obtain a copy of the results of this study, which will be sent to you upon your request. Please feel free to contact us if you have any questions regarding this study, at the following details:

Dr. M. Osama Jannadi
Chairman, CEM Department
P. O. Box: 1978, KFUPM,
Dhahran - 31261
Tel: 860-3590 ; Fax: 860-4453

Engr. M. S. Bu-Khamsin
Saudi Aramco
P. O. Box -795
Abqaiq - 31311
Tel: 572-0213 ; Fax: 572-3971

Thank you for your anticipated cooperation.

Yours Sincerely,

Dr. M. Osama Jannadi
Study Director

Engr. M. S. Bu-Khamsin
Research Associate

King Fahd University Of Petroleum And Minerals
College of Environmental Design
Dept. of Construction Engineering & Management
Dhahran 31261, Saudi Arabia

A. QUESTIONNAIRE INSTRUCTIONS:

1. Please let your **Safety or Loss Prevention Representative** complete the survey questionnaires.
2. Evaluate each factor in terms of its impact on contractor safety performance, using the five options available (Very High=4, High=3, Moderate=2, Low=1, & No Impact=0).
3. Please indicate your feeling regarding the effect of each factor on Contractor Overall Safety Performance. We do not seek your company's status regarding the specific factors.
4. Indicate your choice for each factor by marking the appropriate boxes.
5. Feel free to provide any additional factors, sub-factors or any other comments.

B. GENERAL QUESTIONS:

1. What major type of construction projects do you usually perform?

☐ Highway Construction
☐ General Building (nonresidential)
☐ Utilities Construction
☐ Industrial Construction
☐ Other (specify:----------)

2. Which of the followings does your company use to monitor the safety program quality?

Disabling Injury Frequency Rate	☐	Yes	☐	No
Disabling Severity Rate	☐	Yes	☐	No
Incident Rate	☐	Yes	☐	No

Any Other Criteria (please specify----------)

Please indicate, by marking the appropriate boxes, how you ACTUALLY feel about the level of impact of each factor on the contractor safety performance. Do not answer in terms of your company's safety performance:

LEVEL OF IMPACT FACTORS DESCRIPTION	VERY HIGH	HIGH	MODE RATE	LOW	NO IMPACT
1. SITE PLANNING AND HOUSEKEEPING					
• Site Layout	4☐	3☐	2☐	1☐	0☐
• Safe Means Of Access & Exit	4☐	3☐	2☐	1☐	0☐
• Site illumination	4☐	3☐	2☐	1☐	0☐
2. WELFARE FACILITIES					
• First Aid Facilities	4☐	3☐	2☐	1☐	0☐
• Food & Drinking Water Facilities	4☐	3☐	2☐	1☐	0☐
• Ambulance	4☐	3☐	2☐	1☐	0☐
• Showers & Eyewash Fountains	4☐	3☐	2☐	1☐	0☐
• Smoking Area/Toilet & Washing Facilities	4☐	3☐	2☐	1☐	0☐
3. EMERGENCY / DISASTER PLANNING AND PREPARATION					
• Emergency Response Organization / Procedures	4☐	3☐	2☐	1☐	0☐
• Emergency Response Training / Drills	4☐	3☐	2☐	1☐	0☐
4. SIGNS, SIGNALS AND BARRICADES					
• General Signs (Danger, Caution, Traffic, & Tags)	4☐	3☐	2☐	1☐	0☐
• Flag Men / Wearing Garment (Red or Orange)	4☐	3☐	2☐	1☐	0☐
• Signaling Direction (As per ANSI)	4☐	3☐	2☐	1☐	0☐
• Crane & Hoist Signals (As per ANSI)	4☐	3☐	2☐	1☐	0☐
5. MATERIALS HANDLING, STORAGE & USE					
• Aisles and Driveways	4☐	3☐	2☐	1☐	0☐
• Fence and Access Gates	4☐	3☐	2☐	1☐	0☐
• Arrangement of Materials	4☐	3☐	2☐	1☐	0☐
• Fire Protection Equipment	4☐	3☐	2☐	1☐	0☐

Please indicate, by marking the appropriate boxes, how you ACTUALLY feel about the level of impact of each factor on the contractor safety performance. Do not answer in terms of your company's safety performance:

LEVEL OF IMPACT FACTORS DESCRIPTION	VERY HIGH	HIGH	MODE RATE	LOW	NO IMPACT
6. WELDING AND CUTTING					
• Handling of Cylinders	4☐	3☐	2☐	1☐	0☐
• Daily Inspection of Equipment	4☐	3☐	2☐	1☐	0☐
• Adequate Ventilation	4☐	3☐	2☐	1☐	0☐
• Grounding / Fire Guard	4☐	3☐	2☐	1☐	0☐
• Personal Protective Equipment	4☐	3☐	2☐	1☐	0☐
7. CONCRETE, & CONCRETE FORMWORKS					
• Work Platform / Guardrails	4☐	3☐	2☐	1☐	0☐
• Grounded Electric Vibrator	4☐	3☐	2☐	1☐	0☐
• Experienced Workmanship	4☐	3☐	2☐	1☐	0☐
• Shoring Sketches / Drawings on Site	4☐	3☐	2☐	1☐	0☐
• Forms / Adequate Shoring For Supports	4☐	3☐	2☐	1☐	0☐
8. CRANE AND LIFTING EQUIPMENT					
• Lift Plan on Site	4☐	3☐	2☐	1☐	0☐
• Licensed Operators	4☐	3☐	2☐	1☐	0☐
• Safe Working Load Indicator / Inspection Stickers	4☐	3☐	2☐	1☐	0☐
• Safety Latches (Hooks)	4☐	3☐	2☐	1☐	0☐
• Rigger Training	4☐	3☐	2☐	1☐	0☐
9. CHEMICAL HANDLING					
• Proper Identification / Warning Signals (Arabic / English)	4☐	3☐	2☐	1☐	0☐
• Adequate Storage / Usage	4☐	3☐	2☐	1☐	0☐
• Emergency Treatment	4☐	3☐	2☐	1☐	0☐

Please indicate, by marking the appropriate boxes, how you ACTUALLY feel about the level of impact of each factor on the contractor safety performance. Do not answer in terms of your company's safety performance:

LEVEL OF IMPACT FACTORS DESCRIPTION	VERY HIGH	HIGH	MODERATE	LOW	NO IMPACT
10. ELECTRICAL EQUIPMENT					
• Temporary Installation Precautions	4☐	3☐	2☐	1☐	0☐
• Lockout / Tagging / Warning Signs	4☐	3☐	2☐	1☐	0☐
• Initial Inspection / Tests	4☐	3☐	2☐	1☐	0☐
• Testing of Grounds	4☐	3☐	2☐	1☐	0☐
11. HANDLING, TRANSPORTATION & DISPOSAL OF HAZARDOUS MATERIAL AND WASTE					
• Hazard Identification Plan	4☐	3☐	2☐	1☐	0☐
• Waste Management Plan	4☐	3☐	2☐	1☐	0☐
• Disposal Sites / Disposal Documents	4☐	3☐	2☐	1☐	0☐
12. PERSONAL PROTECTIVE EQUIPMENT					
• Head / Eye / Face/ Hand/ Foot, and Hearing Protection	4☐	3☐	2☐	1☐	0☐
• Fall Restraining / Arresting Devices	4☐	3☐	2☐	1☐	0☐
• Breathing Apparatus	4☐	3☐	2☐	1☐	0☐
13. FIRE PREVENTION					
• Adequate Fire Extinguisher / Locations	4☐	3☐	2☐	1☐	0☐
• Control of Ignition Sources / Fire Watches	4☐	3☐	2☐	1☐	0☐
• Storage of Flammable Liquids / Combustible Materials	4☐	3☐	2☐	1☐	0☐
• Fire Extinguisher Training / Drills	4☐	3☐	2☐	1☐	0☐
• Fire Extinguishers Regular Maintenance	4☐	3☐	2☐	1☐	0☐

Please indicate, by marking the appropriate boxes, how you ACTUALLY feel about the level of impact of each factor on the contractor safety performance. Do not answer in terms of your company's safety performance:

	LEVEL OF IMPACT					
	FACTORS DESCRIPTION	VERY HIGH	HIGH	MODE RATE	LOW	NO IMPACT
14.	**TRANSPORTATION**					
	• Vehicle Condition / Regular Maintenance	4☐	3☐	2☐	1☐	0☐
	• Passenger Seating / Seat Belts Enforcement	4☐	3☐	2☐	1☐	0☐
	• Motor Vehicle Regulations (Saudi Arab Government)	4☐	3☐	2☐	1☐	0☐
	• First Aid Equipment / Fire Extinguishers	4☐	3☐	2☐	1☐	0☐
	• Driver Training	4☐	3☐	2☐	1☐	0☐
15.	**EXCAVATION, TRENCHING & SHORING**					
	• Cave-in Protection (Shoring / Trench Boxes / Sloping / Benching	4☐	3☐	2☐	1☐	0☐
	• Excavation Plan on site	4☐	3☐	2☐	1☐	0☐
	• Access & Exits / Walkways	4☐	3☐	2☐	1☐	0☐
16.	**SCAFFOLDING AND LADDERS**					
	• Adequate Components & Fittings (Frame Members / Base & Sole Plates / Plumb & Level / Planking)	4☐	3☐	2☐	1☐	0☐
	• Experienced Workmanship	4☐	3☐	2☐	1☐	0☐
	• Scaffold Access and Proper Loading	4☐	3☐	2☐	1☐	0☐
	• Adequate Scaffolding Stability (Guardrails / Toeboards / Secured Ties / Foundations and Cross Bracing)	4☐	3☐	2☐	1☐	0☐
17.	**HAND AND POWER TOOLS**					
	• Overall Condition / Daily Inspection	4☐	3☐	2☐	1☐	0☐
	• Individual Tools Precautions	4☐	3☐	2☐	1☐	0☐
	• Selection / Training	4☐	3☐	2☐	1☐	0☐

Please indicate, by marking the appropriate boxes, how you ACTUALLY feel about the level of impact of each factor on the contractor safety performance. Do not answer in terms of your company's safety performance:

	LEVEL OF IMPACT				
FACTORS DESCRIPTION	VERY HIGH	HIGH	MODE RATE	LOW	NO IMPACT
18. MECHANICAL EQUIPMENT					
• Qualified and Certified Operators	4☐	3☐	2☐	1☐	0☐
• Machinery Guards and Safety Protection Devices	4☐	3☐	2☐	1☐	0☐
• Regular Inspections and Strict Maintenance Schedules	4☐	3☐	2☐	1☐	0☐
19. IONIZING RADIATION					
• Health Hazard Identification	4☐	3☐	2☐	1☐	0☐
• Protection Against Radiation (Distance, Time & Shielding)	4☐	3☐	2☐	1☐	0☐
• Adequate Training and Safe Handling	4☐	3☐	2☐	1☐	0☐
• Intensive Inspection Each Shift	4☐	3☐	2☐	1☐	0☐
• Shipping / Transportation / Storage Areas	4☐	3☐	2☐	1☐	0☐
20. MANAGEMENT INVOLVEMENT					
• Initiate / Administer Company's Safety Policy	4☐	3☐	2☐	1☐	0☐
• Know and Adhere to the Requirements of Workmen's Regulations	4☐	3☐	2☐	1☐	0☐
• Ensure Qualified and Well Trained Supervisors	4☐	3☐	2☐	1☐	0☐
• Consider Safety at Tendering, Planning & Contract	4☐	3☐	2☐	1☐	0☐
• Institute & adhere to Loss Prevention Program	4☐	3☐	2☐	1☐	0☐
• Fix accountability of safety	4☐	3☐	2☐	1☐	0☐
• Set a Personal Example	4☐	3☐	2☐	1☐	0☐
• Prepare Hazard Identification Plan	4☐	3☐	2☐	1☐	0☐
• Prepare Emergency Evacuation Procedures	4☐	3☐	2☐	1☐	0☐
• Communicate & Share Safety Program Activities, Experience and Results with Others	4☐	3☐	2☐	1☐	0☐
• Safety motivation (Group Meetings, Literature, Film showings, Posters, Bulletin Boards, Incentives)	4☐	3☐	2☐	1☐	0☐

APPENDIX – B

SAMPLE MEASUREMENT TECHNIQUE

Appendix (B): Sample Measurement Technique

SOURCE: R. Diekemper & D. Spartz (1970, "A quantitative & qualitative measurement of industrial safety activities", ASSE Journal, December, 1970.

	ACTIVITY	POOR	FAIR	GOOD	EXCELLENT
A. ORGANIZATION & ADMINISTRATION					
1	Statement of policy, responsibilities assigned	No statement of loss control policy Responsibility and accountability not assigned.	A general understanding of Loss Control, responsibilities and accountability, but not written.	Loss Control Policy and responsibilities written and distributed to supervisors.	In addition to "Good" Loss Control policy is reviewed annually and is posted. Responsibilities and accountability are emphasized in supervisory performance evaluations.
2	Safe operating procedures (SOP's).	No written SOP's	Written SOP's for some, but not all, hazardous operations.	Written SOP's for all hazardous operations	All hazardous operations covered by a procedure, posted at the job location, with an annual documented review to determine adequacy.
3	Employee selection & placement	Only pre-employment physical examination given	In addition, an aptitude test is administered to new employees	In addition to "Fair" new employees past safety record is considered in their employment.	In addition to "Good" when employees are considered for operation, their safety attitude and record is considered.
4	Emergency and disaster control plans	No plan or procedures.	Verbal understanding on emergency procedures	Written plan outlining the minimum requirements	All types of emergencies covered with written procedures. Responsibilities are defined with back-up personnel provisions.
5	Direct management involvement	No measurable activity	Follow-up on accident problems.	In addition to "Fair" management reviews all injury and property damage reports and holds supervision accountable for verifying firm corrective measures.	In addition to "Good" reviews all investigation reports. Loss Control problems are treated as other operational problems in staff meeting.
6	Plant safety rules.	No written rules.	Plant safety rules have been developed and posted	Plant safety rules are incorporated in the plant work rules.	In addition, plant work rules are firmly enforced and updated at least annually.
B. INDUSTRIAL HAZARD CONTROL					
1	Housekeeping, storage of materials, etc.	Housekeeping is generally poor. Raw materials, items being processed & finished materials are poorly stored.	Housekeeping is fair. Some attempts to adequately store materials are being made.	Housekeeping and storage of materials are orderly. Heavy and bulky objects are well stored out of aisles, etc.	Housekeeping and storage of materials are ideally controlled.
2.	Machine guarding.	Little attempt is made to control hazardous points on machinery	Partial, but inadequate or ineffective, attempts at control are in evidence.	There is evidence of control which meets applicable Federal and State requirements, but improvement may still be made.	Machine hazards are effectively controlled to the extent that injury is unlikely. Safety of operator is given prime consideration at time of process design.
3	General area guarding	Little attempt is made to control such hazards as: unprotected floor openings, slippery or defective floors; stair way surfaces; inadequate illumination, etc.	Partial but inadequate or ineffective maintenance	There is evidence of control which meets applicable Federal and State requirements but further improvement may still be made.	These hazards are effectively controlled to the extent that injury is unlikely
4.	Maintenance of equipment, guards, hand tools, etc.	No systematic program of maintaining guards, hand tools, controls and other safety features of equipment, etc	Partial, but inadequate or ineffective maintenance.	Maintenance program for equipment and safety features is adequate. Electrical hand tools are tested and inspected on a routine basis.	In addition to "Good" a preventive maintenance system is programmed for hazardous equipment and devices. Safety reports, files and safety department consulted when abnormal conditions are found.
5.	Material handling, hand and mechanized.	Little attempt is made to minimize possibility of injury from the handling of materials.	Partial but inadequate or ineffective attempts at control are in evidence.	Loads are limited as to size and shape for handling by hand, and mechanization is provided for heavy or bulky loads.	In addition to control for both hand and mechanized handling, adequate measures prevail to prevent conflict between other workers and material being moved.

Appendix (B): Sample Measurement Technique

SOURCE: R. Diekemper & D. Spartz (1970, "A quantitative & qualitative measurement of industrial safety activities", ASSE Journal, December, 1970.

	ACTIVITY	POOR	FAIR	GOOD	EXCELLENT
6.	Personal protective equipment, adequacy and use.	Proper equipment not provided or is not adequate for specific hazards.	Partial but inadequate or ineffective provision, distribution and use of personal protective equipment.	Proper equipment is provide. Equipment identified for special hazards, distribution is controlled by supervisor. Employee is required to use protective equipment.	Equipment provided complies with standards. Close control maintained by supervision. Use of safety equipment recognized as an employment requirement. Injury record bears this out.
C.	**FIRE CONTROL AND INDUSTRIAL HYGIENE**				
1	Chemical hazard control references	No knowledge or use of reference data.	Data available and used by foremen when needed.	In addition to "Fair" additional standards have been requested when necessary.	Data posted and followed where needed. Additional standards have been promulgated, reviewed with employees involved and posted.
2	Flammable and explosive materials control.	Storage facilities do not meet fire regulations. Containers do not carry name of contents. Approved dispensing equipment not used. Excessive quantities permitted in manufacturing area.	Some storage facilities meet minimum fire regulations. Most containers carry name of contents. Some approved dispensing equipment in use.	Storage facilities meet minimum fire regulations. Most containers carry name of contents. Approved equipment generally is used. Supply at work area is limited to one day requirement. Containers are kept in approved storage cabinets.	In addition to "Good" storage facilities exceed the minimum fire regulations and containers are always labeled. A strong policy is in evidence relative to the control of the handling, storage and use of flammable materials.
3	Ventilation fumes, smoke and dust control.	Ventilation rates are below industrial hygiene standards in areas where there is an industrial hygiene exposure.	Ventilation rates in exposure areas meet minimum standards.	In addition to "Fair" ventilation rates are periodically measured, recorded and maintained at approved levels.	In addition to "Good" equipment is properly selected and maintained close to maximum efficiency.
4.	Skin contamination control.	Little attempt at control or elimination of skin irritation exposure.	Partial, but incomplete program for protecting workers. First-aid reports on skin problems are followed up on an individual basis for determination of cause.	The majority of workmen instructed concerning skin-irritating materials. Workmen provided with approved personal protective equipment or devices. Use of this equipment is enforced.	All workmen informed about skin-irritating materials. Workmen in all cases provided with approved personal protective equipment or devices. Use of proper equipment enforced and facilities and facilities available for maintenance. Workers are encouraged to wash skin frequently. Injury record indicates good control.
5	Fire control measures.	Do not meet minimum insurance or municipal requirements.	Meets minimum requirements.	In addition to "Fair" additional fire hoses and/or extinguishers are provided. Welding permits issued. Extinguishers on all welding carts.	In addition to "Good" a fire crew is organized and trained in emergency procedures and in the use of fire fighting equipment.
6	Waste-trash collection and disposal, air water pollution.	Control measures are inadequate.	Some controls exist for disposal of trash. Controls exist but are ineffective in methods or procedures of collection and disposal. Further study is necessary.	Most waste disposal problems have been identified and control program instituted. There is room for further important.	Waste disposal hazards are effectively controlled. Air/ water pollution potential is minimal.
D.	**SUPERVISORY PARTICIPATION, MOTIVATION AND TRAINING**				
1.	Line supervisory safety training.	All supervisors have not received basic safety training.	All shop supervisors have received some safety training.	All supervisors participated in division safety training session a minimum of twice a year.	In addition, specialized sessions conducted on specific problems.
2.	Indoctrination of new employees.	No program covering the health and safety job requirements.	Verbal only.	A written handout to assist in indoctrination.	A formal indoctrination program to orientate new employees is in effect.

Appendix (B): Sample Measurement Technique

SOURCE: R. Diekemper & D. Spartz (1970, "A quantitative & qualitative measurement of industrial safety activities", ASSE Journal, December, 1970.

	ACTIVITY	POOR	FAIR	GOOD	EXCELLENT
3.	Job hazard analysis	No written program	Job hazard analysis program being implemented on some jobs.	JHA conducted on majority of operations	In addition, job hazard analysis performed on a regular basis and safety procedures written and posted for all operations.
4.	Training for specialized operations (Fork trucks, grinding, press brakes, punch presses, solvent handling, etc.)	Inadequate training given for specialized operations	An occasional training program given for specialized operations	Safety training is given for all specialized operations on a regular basis and training given periodically to review correct procedures	In addition to "Good" an evaluation is performed annually to determine training needs.
5.	Internal self-inspection	No written program to identify and evaluate hazardous practices and/or conditions	Plant relies on outside source, i.e., Insurance safety Engineer and assumes each supervisor inspects his area.	A written program outlining inspection guidelines, responsibilities, frequency and follow up is in effect.	Inspection program is measured by results, i.e., reduction in accidents and costs, Inspection results are followed by top management.
6.	Safety promotion and publicity	Bulletin boards and posters are considered the primary means for safety promotion	Additional safety displays, demonstrations, films, are used infrequently	Safety displays and demonstrations are used on a regular basis	Special display cabinets, windows, etc. are provided. Displays are used regularly and are keyed to special themes
7.	Employee/supervisor safety contact & communication	Little or no attempt made by supervisor to discuss safety with employees	Infrequent safety discussion between supervisor and employees	Supervisors regularly cover safety when reviewing work practices with individual employees	In addition to "Good" supervisors make good use of the shop safety plan and regularly review job safety requirements with each worker
E. ACCIDENT INVESTIGATION, STATISTICS AND REPORTING PROCEDURES					
1.	Accident investigation by line personnel	No accident investigation made by the supervision	Line supervision makes investigation of only medical injuries.	Line supervision trained and makes complete and effective investigations of all accidents; the cause is determined, corrective measures initiated immediately	In addition to "Good" investigation is made of every accident within 24 hours of occurrence. Reports are reviewed by the department manager and plant manager
2.	Accident cause and injury location analysis and statistics.	No analysis of disabling and medical cases to identify prevalent causes of accidents and location where they occur	Effective analysis by both cause and location maintained on medical and first-aid cases	In addition to "Fair" results are used to pin-point accident causes so accident prevention objectives can be established.	Accident causes and injuries are graphically illustrated to develop the trends and evaluate performance. Management is kept informed on status.
3.	Investigation of property damage	No program.	Verbal requirement or general practice to inquire about property damage accidents.	Written requirement that all property damage accidents of $50 and more will be investigated.	In addition, management requires a vigorous investigation effort on all property damage accidents.
4.	Proper reporting of accidents and contact with carrier	Accident reporting procedures are inadequate.	Accidents are correctly reported on a timely basis.	In addition to "Fair" accidents records are maintained for analysis purposes.	In addition to "Good" there is a close liaison with the insurance carrier

APPENDIX - C

COMPANIES PARTICIPATING IN SURVEY

Appendix - C: Companies Participated In The Questionnaire

S. No.	COMPANY NAME	P. O. BOX	CITY	CODE
1	MOHAMMAD AL-MOJIL GROUP	11	DAMMAM	31411
2	M. S. AL-SUWAIDI ESTABLISHMENT FOR CONTRACTING	12	RAST ANURA	31941
3	A. H. AL-SHUWAYER TRADING AND CONTRACTING COMPANY	322	DAMMAM	31411
4	L. G. CONSTRUCTION COMPANY LTD.	23	ABQAIQ	31922
5	BELLELI SAUDI HEAVY INDUSTRIES LTD.	10138	JUBAIL INDL.	31961
6	TAMIMI GROUP	172	DAMMAM	31411
7	HUSSEIN AL-ALI ESTABLISHMENT	509	HOFUF	31982
8	ABDULLAH A. AL-KHODARI SONS COMPANY	3589	KHOBAR	31952
9	FOUAD A. FOUAD CORPORATION	806	DAMMAM	31421
10	ARABIAN CBI TANK MANUFACTURING COMPANY LTD.	1218	DAMMAM	31431
11	CONSOLIDATED CONTRACTORS COMPANY (W. L. L.)	1598	JUBAIL	31951
12	HADI HAIDER & BROS. COMPANY	118	RAHIMA	31941
13	NESMA & AL-FADL CONTRACTING COMPANY LTD.	1498	KHOBAR	31952
14	AGAP ARABIA LTD.	539	JUBAIL	31951
15	SAUD A. AL-TWAJRI ESTABLISHMENT	852	JUBAIL	31951
16	NASSIR HAZZA & BROTHERS COMPANY LTD.	12	KHOBAR	31952
17	ARABIAN FAL COMPANY FOR CONTRACTING AND TRADING	88	RAS TANURA	31941
18	KHONAINI INTERNATIONAL COMPANY LTD.	30	JUBAIL	31951
19	ISCOSA INDUSTRIED AND MAINTENANCE LTD.	1032	DAMMAM	31431
20	GLOBAL SUHAIMI COMPANY (W. L. L.)	2162	DAMMAM	31451
21	ABB CONTRACTING COMPANY LTD.	2873	KHOBAR	31952
22	A. A. TURKI CORPORATION	718	DAMMAM	31421
23	HADIA H. AL-HAMMAM ESTABLISHMENT	230	RAHIMAH	31941
24	DOWELL SHLUMBERGER	2847	KHOBAR	31952
25	SCADO/JAFFAR AL-HAMOOD ESTABLISHMENT	350	DAMMAM	31411

APPENDIX-D

THE PC-BASED EVALUATION TOOL COMPUTER CODES

```
PC TOOL CODES
FORM1-1
Private Sub Command3_Click()
'PC-BASED EVALUATION TOOL's TITLE SCREEN
'Form54 Re-set
Form54.text2.Text = ""
'Form4 Options
Form4.Option1.Value = False
Form4.Option2.Value = False
Form4.Option3.Value = False
Form4.Option4.Value = False
Form4.Option5.Value = False
Form4.Option6.Value = False
Form4.Option7.Value = False
Form4.Option8.Value = False
Form4.Option9.Value = False
Form4.Option10.Value = False
'Form29 Options
Form29.Option1.Value = False
Form29.Option2.Value = False
Form29.Option3.Value = False
Form29.Option4.Value = False
Form29.Option5.Value = False
Form29.Option6.Value = False
Form29.Option7.Value = False
Form29.Option8.Value = False
Form29.Option9.Value = False
Form29.Option10.Value = False
'Form30 Options
Form30.Option1.Value = False
Form30.Option2.Value = False
Form30.Option3.Value = False
Form30.Option4.Value = False
Form30.Option5.Value = False
Form30.Option6.Value = False
Form30.Option7.Value = False
Form30.Option8.Value = False
Form30.Option9.Value = False
Form30.Option10.Value = False
'Form31 Options
Form31.Option1.Value = False
Form31.Option2.Value = False
Form31.Option3.Value = False
Form31.Option4.Value = False
Form31.Option5.Value = False
Form31.Option6.Value = False
Form31.Option7.Value = False
Form31.Option8.Value = False
Form31.Option9.Value = False
Form31.Option10.Value = False
'Site Planning
For i = 0 To 11
Form5.Option3(i).Value = False
Next I
Form5.Label1.Caption = ""
Form5.label2.Caption = ""
For i = 0 To 3
Form5.text3(i).Text = ""
Form5.Label3(i).Caption = ""
Next i
'Welfare Facilities
Form7.label2.Caption = ""
For i = 0 To 2
Form7.text3(i).Text = ""
Form7.Label3(i).Caption = ""
Next i
'Signs, Signals & Barricades
For i = 0 To 15
Form8.Option3(i).Value = False
Next i
Form8.Label1.Caption = ""
Form8.label2.Caption = ""
For i = 0 To 4
Form8.text3(i).Text = ""
Form8.Label3(i).Caption = ""
Next i
'Materials Handling, Storage & Use
For i = 0 To 15
Form12.Option3(i).Value = False
Next i
Form12.Label1.Caption = ""
Form12.label2.Caption = ""
For i = 0 To 4
Form12.text3(i).Text = ""
Form12.Label3(i).Caption = ""
Next i
'Welding & Cutting
For i = 0 To 19
Form13.Option3(i).Value = False
Next i
Form13.Label1.Caption = ""
Form13.label2.Caption = ""
For i = 0 To 5
Form13.text3(i).Text = ""
Form13.Label3(i).Caption = ""
Next i
'Concrete and Concrete Formworks
For i = 0 To 19
Form14.Option3(i).Value = False
Next i
Form14.Label1.Caption = ""
Form14.label2.Caption = ""
For i = 0 To 5
Form14.text3(i).Text = ""
Form14.Label3(i).Caption = ""
Next i
'Crane and Lifting Equipment
For i = 0 To 19
Form15.Option3(i).Value = False
Next i
Form15.Label1.Caption = ""
Form15.label2.Caption = ""
For i = 0 To 5
Form15.text3(i).Text = ""
Form15.Label3(i).Caption = ""
Next i
'Chemical Handling
For i = 0 To 11
Form16.Option3(i).Value = False
Next i
Form16.Label1.Caption = ""
Form16.label2.Caption = ""
For i = 0 To 3
```

PC-BASED EVALUATION TOOL CODES

```
For i = 0 To 19
Form6.Option3(i).Value = False
Next i
Form6.Label1.Caption = ""
Form6.label2.Caption = ""
For i = 0 To 5
Form6.text3(i).Text = ""
Form6.Label3(i).Caption = ""
Next i
Form1-2
'Emergency/Disaster Planning & Preparation
For i = 0 To 7
Form7.Option3(i).Value = False
Next i
Form7.Label1.Caption = ""
'Handling, Transportation & Disposal of
Hazardous Material & Waste
For i = 0 To 11
Form18.Option3(i).Value = False
Next i
Form18.Label1.Caption = ""
Form18.label2.Caption = ""
For i = 0 To 3
Form18.text3(i).Text = ""
Form18.Label3(i).Caption = ""
Next i
'Personal Protective Equipment
For i = 0 To 11
Form19.Option3(i).Value = False
Next i
Form19.Label1.Caption = ""
Form19.label2.Caption = ""
For i = 0 To 3
Form19.text3(i).Text = ""
Form19.Label3(i).Caption = ""
Next i
'Fire Prevention
For i = 0 To 19
Form20.Option3(i).Value = False
Next i
Form20.Label1.Caption = ""
Form20.label2.Caption = ""
For i = 0 To 5
Form20.text3(i).Text = ""
Form20.Label3(i).Caption = ""
Next i
'Transportation
For i = 0 To 19
Form21.Option3(i).Value = False
Next i
Form21.Label1.Caption = ""
Form21.label2.Caption = ""
For i = 0 To 5
Form21.text3(i).Text = ""
Form21.Label3(i).Caption = ""
Next i
'Excavation, Trenching & Shoring
For i = 0 To 11
Form22.Option3(i).Value = False
Next i
Form22.Label1.Caption = ""
Form22.label2.Caption = ""
Form16.text3(i).Text = ""
Form16.Label3(i).Caption = ""
Next i
'Electrical Equipment
For i = 0 To 15
Form17.Option3(i).Value = False
Next i
Form17.Label1.Caption = ""
Form17.label2.Caption = ""
For i = 0 To 4
Form17.text3(i).Text = ""
Form17.Label3(i).Caption = ""
Next i

Form25.label2.Caption = ""
For i = 0 To 3
Form25.text3(i).Text = ""
Form25.Label3(i).Caption = ""
Next i
'Ionization Radiation
For i = 0 To 19
Form26.Option3(i).Value = False
Next i
Form26.Label1.Caption = ""
Form26.label2.Caption = ""
For i = 0 To 5
Form26.text3(i).Text = ""
Form26.Label3(i).Caption = ""
Next i
'Management Involvement - 1
For i = 0 To 23
Form27.Option3(i).Value = False
Next i
Form27.Label1.Caption = ""
Form27.label2.Caption = ""
For i = 0 To 6
Form27.text3(i).Text = ""
Form27.Label3(i).Caption = ""
Next i
'Management Involvement - 2
For i = 0 To 19
Form28.Option3(i).Value = False
Next i
Form28.Label1.Caption = ""
Form28.label2.Caption = ""
For i = 0 To 5
Form28.text3(i).Text = ""
Form28.Label3(i).Caption = ""
Next i
For i = 0 To 4
Form4.label2(i).Caption = ""
Form29.label2(i).Caption = ""
Form30.label2(i).Caption = ""
Form31.label2(i).Caption = ""
Next i
End Sub
Private Sub Command2_Click()
End
End Sub
'PC-BASED EVALUATION TOOL's TITLE
SCREEN
'Form54 Re-set
```

PC-BASED EVALUATION TOOL CODES

```
For i = 0 To 3
Form22.text3(i).Text = ""
Form22.Label3(i).Caption = ""
Next i
'Scaffolding and Ladders
For i = 0 To 15
Form23.Option3(i).Value = False
Next i
Form23.Label1.Caption = ""
Form23.label2.Caption = ""
For i = 0 To 4
Form23.text3(i).Text = ""
Form23.Label3(i).Caption = ""
Next i
'Hand and Power Tools
For i = 0 To 11
Form24.Option3(i).Value = False
Next i
Form24.Label1.Caption = ""
Form24.label2.Caption = ""
For i = 0 To 3
Form24.text3(i).Text = ""
Form24.Label3(i).Caption = ""
Next i
'Mechanical Equipment
For i = 0 To 11
Form25.Option3(i).Value = False
Next i
Form25.Label1.Caption = ""
Form30.Option6.Value = False
Form30.Option7.Value = False
Form30.Option8.Value = False
Form30.Option9.Value = False
Form30.Option10.Value = False
'Form31 Options
Form31.Option1.Value = False
Form31.Option2.Value = False
Form31.Option3.Value = False
Form31.Option4.Value = False
Form31.Option5.Value = False
Form31.Option6.Value = False
Form31.Option7.Value = False
Form31.Option8.Value = False
Form31.Option9.Value = False
Form31.Option10.Value = False
'Site Planning
For i = 0 To 11
Form5.Option3(i).Value = False
Next i
Form5.Label1.Caption = ""
Form5.label2.Caption = ""
For i = 0 To 3
Form5.text3(i).Text = ""
Form5.Label3(i).Caption = ""
Next i
'Welfare Facilities
For i = 0 To 19
Form6.Option3(i).Value = False
Next i
Form6.Label1.Caption = ""
Form6.label2.Caption = ""
For i = 0 To 5
Form54.text2.Text = ""
'Form4 Options
Form4.Option1.Value = False
Form4.Option2.Value = False
Form4.Option3.Value = False
Form4.Option4.Value = False
Form4.Option5.Value = False
Form4.Option6.Value = False
Form4.Option7.Value = False
Form4.Option8.Value = False
Form4.Option9.Value = False
Form4.Option10.Value = False
'Form29 Options
Form29.Option1.Value = False
Form29.Option2.Value = False
Form29.Option3.Value = False
Form29.Option4.Value = False
Form29.Option5.Value = False
Form29.Option6.Value = False
Form29.Option7.Value = False
Form29.Option8.Value = False
Form29.Option9.Value = False
Form29.Option10.Value = False
'Form30 Options
Form30.Option1.Value = False
Form30.Option2.Value = False
Form30.Option3.Value = False
Form30.Option4.Value = False
Form30.Option5.Value = False
'Concrete and Concrete Formworks
For i = 0 To 19
Form14.Option3(i).Value = False
Next i
Form14.Label1.Caption = ""
Form14.label2.Caption = ""
For i = 0 To 5
Form14.text3(i).Text = ""
Form14.Label3(i).Caption = ""
Next i
'Crane and Lifting Equipment
For i = 0 To 19
Form15.Option3(i).Value = False
Next i
Form15.Label1.Caption = ""
Form15.label2.Caption = ""
For i = 0 To 5
Form15.text3(i).Text = ""
Form15.Label3(i).Caption = ""
Next i
'Chemical Handling
For i = 0 To 11
Form16.Option3(i).Value = False
Next i
Form16.Label1.Caption = ""
Form16.label2.Caption = ""
For i = 0 To 3
Form16.text3(i).Text = ""
Form16.Label3(i).Caption = ""
Next i
'Electrical Equipment
For i = 0 To 15
Form17.Option3(i).Value = False
```

PC-BASED EVALUATION TOOL CODES

```
Form6.text3(i).Text = ""
Form6.Label3(i).Caption = ""
Next i
'Emergency/Disaster Planning & Preparation
For i = 0 To 7
Form7.Option3(i).Value = False
Next i
Form7.Label1.Caption = ""
Form7.label2.Caption = ""
For i = 0 To 2
Form7.text3(i).Text = ""
Form7.Label3(i).Caption = ""
Next i
'Signs, Signals & Barricades
For i = 0 To 15
Form8.Option3(i).Value = False
Next i
Form8.Label1.Caption = ""
Form8.label2.Caption = ""
For i = 0 To 4
Form8.text3(i).Text = ""
Form8.Label3(i).Caption = ""
Next i
'Materials Handling, Storage & Use
For i = 0 To 15
Form12.Option3(i).Value = False
Next i
Form12.Label1.Caption = ""
Form12.label2.Caption = ""
For i = 0 To 4
Form12.text3(i).Text = ""
Form12.Label3(i).Caption = ""
Next i
'Welding & Cutting
For i = 0 To 19
Form13.Option3(i).Value = False
Next i
Form13.Label1.Caption = ""
Form13.label2.Caption = ""
For i = 0 To 5
Form13.text3(i).Text = ""
Form13.Label3(i).Caption = ""
Next i
Form21.label2.Caption = ""
For i = 0 To 5
Form21.text3(i).Text = ""
Form21.Label3(i).Caption = ""
Next i
'Excavation, Trenching & Shoring
For i = 0 To 11
Form22.Option3(i).Value = False
Next i
Form22.Label1.Caption = ""
Form22.label2.Caption = ""
For i = 0 To 3
Form22.text3(i).Text = ""
Form22.Label3(i).Caption = ""
Next i
'Scaffolding and Ladders
For i = 0 To 15
Form23.Option3(i).Value = False
Next i
Next i
Form17.Label1.Caption = ""
Form17.label2.Caption = ""
For i = 0 To 4
Form17.text3(i).Text = ""
Form17.Label3(i).Caption = ""
Next i
'Handling, Transportation & Disposal of
Hazardous Material & Waste
For i = 0 To 11
Form18.Option3(i).Value = False
Next i
Form18.Label1.Caption = ""
Form18.label2.Caption = ""
For i = 0 To 3
Form18.text3(i).Text = ""
Form18.Label3(i).Caption = ""
Next i
'Personal Protective Equipment
For i = 0 To 11
Form19.Option3(i).Value = False
Next i
Form19.Label1.Caption = ""
Form19.label2.Caption = ""
For i = 0 To 3
Form19.text3(i).Text = ""
Form19.Label3(i).Caption = ""
Next i
'Fire Prevention
For i = 0 To 19
Form20.Option3(i).Value = False
Next i
Form20.Label1.Caption = ""
Form20.label2.Caption = ""
For i = 0 To 5
Form20.text3(i).Text = ""
Form20.Label3(i).Caption = ""
Next i
'Transportation
For i = 0 To 19
Form21.Option3(i).Value = False
Next i
Form21.Label1.Caption = ""
Form4.label2(i).Caption = ""
Form29.label2(i).Caption = ""
Form30.label2(i).Caption = ""
Form31.label2(i).Caption = ""
Next i
End Sub

FORM11-1
Private Sub Command1_Click()
'Help for Site Planning and Housekeeping
'-------------------------
Form5.Show
Form10.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form10.Hide
End Sub
Private Sub Command3_Click()
```

```
Form23.Label1.Caption = ""
Form23.label2.Caption = ""
For i = 0 To 4
Form23.text3(i).Text = ""
Form23.Label3(i).Caption = ""
Next i
'Hand and Power Tools
For i = 0 To 11
Form24.Option3(i).Value = False
Next i
Form24.Label1.Caption = ""
Form24.label2.Caption = ""
For i = 0 To 3
Form24.text3(i).Text = ""
Form24.Label3(i).Caption = ""
Next i
'Mechanical Equipment
For i = 0 To 11
Form25.Option3(i).Value = False
Next i
Form25.Label1.Caption = ""
Form25.label2.Caption = ""
For i = 0 To 3
Form25.text3(i).Text = ""
Form25.Label3(i).Caption = ""
Next i
'Ionization Radiation
For i = 0 To 19
Form26.Option3(i).Value = False
Next i
Form26.Label1.Caption = ""
Form26.label2.Caption = ""
For i = 0 To 5
Form26.text3(i).Text = ""
Form26.Label3(i).Caption = ""
Next i
'Management Involvement - 1
For i = 0 To 23
Form27.Option3(i).Value = False
Next i
Form27.Label1.Caption = ""
Form27.label2.Caption = ""
For i = 0 To 6
Form27.text3(i).Text = ""
Form27.Label3(i).Caption = ""
Next i
'Management Involvement - 2
For i = 0 To 19
Form28.Option3(i).Value = False
Next i
Form28.Label1.Caption = ""
Form28.label2.Caption = ""
For i = 0 To 5
Form28.text3(i).Text = ""
Form28.Label3(i).Caption = ""
Next i
For i = 0 To 4
'Next j
'Form12.Text3(4).Visible = 0
'For i = 0 To 3
'Form12.Frame1(i).Visible = 1
'Form12.Text3(i).Visible = 0
End
End Sub
Private Sub Command1_Click()
'Help for Welfare Facilities
'_____
Form2.Show
Form11.Hide
End Sub
Private Sub Command2_Click()
Form6.Show
Form11.Hide
End Sub
Private Sub Command3_Click()
End
End Sub

FORM12-1
Public Sub updatelabel()
'Materials Handling, Storage and Use
Dim wf(5)
wf(4) = 0.43
wf(0) = 0.22
wf(1) = 0.21
wf(2) = 0.23
wf(3) = 0.34
For i = 0 To 4
If Form12.text3(i).Text <> "" Then
wf(i) = Form12.Label3(i).Caption
Else
Form12.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 15 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form12.Label3(4).Caption
Form4.label2(4).Caption = wwf *
Form12.Label3(4).Caption
End Sub
Private Sub Command1_Click()
Form4.Show
Form12.Hide
Form4.Option15.Value = False
Form4.Option10.Value = False
'For j = 0 To 5
'Form12.Text4(j).Visible = 1
wf(5) = 0.47
wf(0) = 0.17
wf(1) = 0.18
wf(2) = 0.18
```

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```
'Form12.Text3(i).Enabled = 0
'Form12.text2(i).Enabled = 0
'Next i
'Form12.Label1.Visible = 1
'Form12.label2.Visible = 1
'Form12.Label3(4).Visible = 0
End Sub
Private Sub Command2_Click()
Form34.Show
Form12.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form12.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 3
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 4
Form12.Label3(i).Caption = Form12.text3(i).Text
Next i
Else
For i = 0 To 3
Form12.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 4
'Form12.Label3(i).Caption =
Form12.Text3(i).Text
'Next i
End Sub
Private Sub Command1_Click()
Form29.Show
Form13.Hide
Form29.Option11.Value = False
Form29.Option2.Value = False
'For j = 0 To 3
'Form13.Text4(j).Visible = 1
'Next j
'Form13.Text3(5).Visible = 0
'For i = 0 To 4
'Form13.Frame1(i).Visible = 1
'Form13.Text3(i).Visible = 0
'Form13.Text3(i).Enabled = 0
'Form13.text2(i).Enabled = 0
'Next i
wf(3) = 0.24
wf(4) = 0.23
For i = 0 To 5
If Form13.text3(i).Text <> "" Then
wf(i) = Form13.Label3(i).Caption
Else
Form13.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 19 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form13.Label3(5).Caption
Form29.label2(0).Caption = wwf *
Form13.Label3(5).Caption
End Sub
Private Sub Command2_Click()
Form35.Show
Form13.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form13.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 4
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 5
Form13.Label3(i).Caption = Form13.text3(i).Text
Next i
Else
For i = 0 To 4
Form13.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
```

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```
'Form13.Text1(0).Visible = 1
'Form13.Text1(2).Visible = 1
'Form13.Label1.Visible = 1
'Form13.label2.Visible = 1
'Form13.Label3(5).Visible = 0
End Sub
FORM13-1
Public Sub updatelabel()
'Welding and Cutting
Dim wf(6)
wf(0) = 0.17
wf(1) = 0.21
wf(2) = 0.22
wf(3) = 0.18
wf(4) = 0.22
For i = 0 To 5
If Form14.text3(i).Text <> "" Then
wf(i) = Form14.Label3(i).Caption
Else
Form14.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 19 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form14.Label3(5).Caption
Form29.label2(1).Caption = wwf *
Form14.Label3(5).Caption
End Sub
Private Sub Command1_Click()
Form29.Show
Form14.Hide
Form29.Option12.Value = False
Form29.Option4.Value = False
'For j = 0 To 3
'Form14.Text4(j).Visible = 1
'Next j
'Form14.Text3(5).Visible = 0
'For i = 0 To 4
'Form14.Frame1(i).Visible = 1
'Form14.Text3(i).Visible = 0
'Form14.Text3(i).Enabled = 0
'Form14.text2(i).Enabled = 0
'Next i
'Form14.Text1(0).Visible = 1
'Form14.Text1(2).Visible = 1
'Form14.Label1.Visible = 1
'Form14.label2.Visible = 1
'Form14.Label3(5).Visible = 0
End Sub
Public Sub updatelabel2()
'For i = 0 To 5
'Form13.Label3(i).Caption = Form13.Text3(i).Text
'Next i
End Sub

Form14-1
Public Sub updatelabel()
'Concrete and Concrete Formworks
Dim wf(6)
wf(5) = 0.46
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 5
'Form14.Label3(i).Caption = Form14.Text3(i).Text
'Next i
End Sub

FORM-15-1
Public Sub updatelabel()
'Crane and Lifting Equipment
Dim wf(6)
wf(5) = 0.56
wf(0) = 0.2
wf(1) = 0.21
wf(2) = 0.2
wf(3) = 0.2
wf(4) = 0.19
For i = 0 To 5
If Form15.text3(i).Text <> "" Then
wf(i) = Form15.Label3(i).Caption
Else
Form15.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 19 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form15.Label3(5).Caption
Form29.label2(2).Caption = wwf *
Form15.Label3(5).Caption
End Sub
```

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```
Private Sub Command2_Click()
Form36.Show
Form14.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form14.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 4
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 5
Form14.Label3(i).Caption = Form14.text3(i).Text
Next i
Else
For i = 0 To 4
Form14.Label3(i).Caption = "Error"
Next i
Form2.Show
Form15.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 4
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 5
Form15.Label3(i).Caption = Form15.text3(i).Text
Next i
Else
For i = 0 To 4
Form15.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 5
'Form15.Label3(i).Caption =
Form15.Text3(i).Text
'Next i
End Sub
```

FORM-16

```
Private Sub Command1_Click()
Form29.Show
Form15.Hide
Form29.Option13.Value = False
Form29.Option6.Value = False
'For j = 0 To 3
'Form15.Text4(j).Visible = 1
'Next j
'Form15.Text3(5).Visible = 0
'For i = 0 To 4
'Form15.Frame1(i).Visible = 1
'Form15.Text3(i).Visible = 0
'Form15.Text3(i).Enabled = 0
'Form15.text2(i).Enabled = 0
'Next i
'Form15.Text1(0).Visible = 1
'Form15.Text1(2).Visible = 1
'Form15.Label1.Visible = 1
'Form15.label2.Visible = 1
'Form15.Label3(5).Visible = 0
End Sub
Private Sub Command2_Click()
Form37.Show
Form15.Hide
End Sub
Private Sub Command3_Click()
'Form16.Frame1(i).Visible = 1
'Form16.Text3(i).Visible = 0
'Form16.Text3(i).Enabled = 0
'Form16.text2(i).Enabled = 0
'Form16.Text4(i).Visible = 1
'Form16.Text4(i + 3).Visible = 1
'Form16.Label3(i).Visible = 0
'Next i
'Form16.Label1.Visible = 1
'Form16.label2.Visible = 1
End Sub
Private Sub Command2_Click()
Form38.Show
Form16.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form16.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 2
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 3
Form16.Label3(i).Caption = Form16.text3(i).Text
Next i
Else
For i = 0 To 2
Form16.Label3(i).Caption = "Error"
Next i
```

PC-BASED EVALUATION TOOL CODES

```
Public Sub updatelabel()
'Chemical Handling
Dim wf(4)
wf(3) = 0.49
wf(0) = 0.33
wf(1) = 0.3
wf(2) = 0.37
For i = 0 To 3
If Form16.text3(i).Text <> "" Then
wf(i) = Form16.Label3(i).Caption
Else
Form16.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 11 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form16.Label3(3).Caption
Form29.label2(3).Caption = wwf *
Form16.Label3(3).Caption
End Sub
Private Sub Command1_Click()
Form29.Show
Form16.Hide
Form29.Option14.Value = False
Form29.Option8.Value = False
'Form16.Text3(3).Visible = 0
'Form16.Label3(3).Visible = 0
'For i = 0 To 2
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form17.Label3(4).Caption
Form29.label2(4).Caption = wwf *
Form17.Label3(4).Caption
End Sub
Private Sub Command1_Click()
Form29.Show
Form17.Hide
Form29.Option15.Value = Value
Form29.Option10.Value = False
'For j = 0 To 5
'Form17.Text4(j).Visible = 1
'Next j
'Form17.Text3(4).Visible = 0
'For i = 0 To 3
'Form17.Frame1(i).Visible = 1
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 3
'Form16.Label3(i).Caption = Form16.Text3(i).Text
'Next i
End Sub

FORM17-1
Public Sub updatelabel()
'Electrical Equipment
Dim wf(5)
wf(4) = 0.51
wf(0) = 0.23
wf(1) = 0.25
wf(2) = 0.24
wf(3) = 0.28
For i = 0 To 4
If Form17.text3(i).Text <> "" Then
wf(i) = Form17.Label3(i).Caption
Else
Form17.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 15 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
wf(2) = 0.26
For i = 0 To 3
If Form18.text3(i).Text <> "" Then
wf(i) = Form18.Label3(i).Caption
Else
Form18.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 11 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
```

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```
'Form17.Text3(i).Visible = 0
'Form17.Text3(i).Enabled = 0
'Form17.text2(i).Enabled = 0
'Next i
'Form17.Label1.Visible = 1
'Form17.label2.Visible = 1
'Form17.Label3(4).Visible = 0
End Sub
Private Sub Command2_Click()
Form39.Show
Form17.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form17.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 3
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 4
Form17.Label3(i).Caption = Form17.text3(i).Text
Next i
Else
For i = 0 To 3
Form17.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 4
'Form17.Label3(i).Caption =
Form17.Text3(i).Text
'Next i
End Sub
```

FORM18-1

```
Public Sub updatelabel()
'Handling, Transportation and Disposal of
Hazardous Material and Waste
Dim wf(4)
wf(3) = 0.46
wf(0) = 0.41
wf(1) = 0.33
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
Label1.Caption = wwf
label2.Caption = wwf * Form18.Label3(3).Caption
Form30.label2(0).Caption = wwf *
Form18.Label3(3).Caption
End Sub
Private Sub Command1_Click()
Form30.Show
Form18.Hide
Form30.Option11.Value = False
Form30.Option2.Value = False
End Sub
Private Sub Command2_Click()
Form40.Show
Form18.Hide
'Form18.Text3(3).Visible = 0
'Form18.Label3(3).Visible = 0
'For i = 0 To 2
'Form18.Frame1(i).Visible = 1
'Form18.Text3(i).Visible = 0
'Form18.Text3(i).Enabled = 0
'Form18.text2(i).Enabled = 0
'Form18.Text4(i).Visible = 1
'Form18.Text4(i + 3).Visible = 1
'Form18.Label3(i).Visible = 0
'Next i
'Form18.Label1.Visible = 1
'Form18.label2.Visible = 1
'End Sub
Private Sub Command3_Click()
Form2.Show
Form18.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 2
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 3
Form18.Label3(i).Caption = Form18.text3(i).Text
Next i
Else
For i = 0 To 2
Form18.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
If text3(0) = "" Then GoTo 10
For i = 0 To 2
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 3
Form19.Label3(i).Caption = Form19.text3(i).Text
Next i
```

```
'For i = 0 To 3
'Form18.Label3(i).Caption =
Form18.Text3(i).Text
'Next i
End Sub
```

FORM19-1

```
Public Sub updatelabel()
'Personal Protective Equipment
Dim wf(4)
wf(3) = 0.6
wf(0) = 0.34
wf(1) = 0.33
wf(2) = 0.33
For i = 0 To 3
If Form19.text3(i).Text <> "" Then
wf(i) = Form19.Label3(i).Caption
Else
Form19.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 11 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form19.Label3(3).Caption
Form30.label2(1).Caption = wwf *
Form19.Label3(3).Caption
End Sub
Private Sub Command1_Click()
Form30.Show
Form19.Hide
Form30.Option12.Value = False
Form30.Option4.Value = False
'Form19.Text3(3).Visible = 0
'Form19.Label3(3).Visible = 0
'For i = 0 To 2
'Form19.Frame1(i).Visible = 1
'Form19.Text3(i).Visible = 0
'Form19.Text3(i).Enabled = 0
'Form19.text2(i).Enabled = 0
'Form19.Text4(i).Visible = 1
'Form19.Text4(i + 3).Visible = 1
'Form19.Label3(i).Visible = 0
'Next i
'Form19.Label1.Visible = 1
'Form19.label2.Visible = 1
End Sub
Private Sub Command2_Click()
Form41.Show
Else
For i = 0 To 2
Form19.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 3
'Form19.Label3(i).Caption = Form19.Text3(i).Text
'Next i
End Sub
```

FORM2-1

```
Private Sub Command1_Click()
'PC-Based Evaluation Tool Main Menu
'-------------------------
Form3.Show
Form2.Hide
End Sub
Private Sub Command2_Click()
Form4.Show
For i = 0 To 4
Form4.text2(i).Enabled = 0
Form4.label2(i).Visible = 1
Form29.text2(i).Enabled = 0
Form29.label2(i).Visible = 1
Form30.text2(i).Enabled = 0
Form30.label2(i).Visible = 1
Form31.text2(i).Enabled = 0
Form31.label2(i).Visible = 1
Next i
Form2.Hide
Form4.Option1.Value = False
'Form4.Option2.Value = False
Form4.Option3.Value = False
'Form4.Option4.Value = False
Form4.Option5.Value = False
'Form4.Option6.Value = False
Form4.Option7.Value = False
'Form4.Option8.Value = False
Form4.Option9.Value = False
'Form4.Option10.Value = False
Form29.Option1.Value = False
'Form29.Option2.Value = False
Form29.Option3.Value = False
'Form29.Option4.Value = False
Form29.Option5.Value = False
'Form29.Option6.Value = False
Form29.Option7.Value = False
'Form29.Option8.Value = False
Form29.Option9.Value = False
'Form29.Option10.Value = False
Form30.Option1.Value = False
'Form30.Option2.Value = False
```

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```
Form19.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form19.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
'Form30.Option10.Value = False
Form31.Option1.Value = False
'Form31.Option2.Value = False
Form31.Option3.Value = False
'Form31.Option4.Value = False
'Form31.Option5.Value = False
'Form31.Option6.Value = False
Form31.Option7.Value = False
'Form31.Option8.Value = False
'Form31.Option9.Value = False
'Form31.Option10.Value = False
'-------------------
' Site Planning & Housing
Form5.text3(3).Visible = 0
Form5.Label3(3).Visible = 0
Form5.text2(3).Visible = 1
Form5.text3(4).Visible = 0
Form5.Label3(4).Visible = 0
For i = 0 To 2
Form5.Frame1(i).Visible = 1
Form5.text3(i).Visible = 0
Form5.text3(i).Enabled = 0
Form5.text2(i).Enabled = 0
Form5.Text4(i).Visible = 1
Form5.Text4(i + 3).Visible = 1
Form5.Label3(i).Visible = 0
Next i
Form5.Label1.Visible = 1
Form5.label2.Visible = 1
For i = 0 To 4
Form5.Label4(i).Visible = 0
Next i
Form5.Command5.Visible = 0
'If Form4.Option2.Value = True Then
'Form4.label2(0).Caption = 0
'End If
'-------------------
' Welfare Facilities
Form6.text2(5).Visible = 1
For j = 0 To 3
Form6.Text4(j).Visible = 1
Next j
Form6.text3(5).Visible = 0
For i = 0 To 4
Form6.Frame1(i).Visible = 1
Form6.text3(i).Visible = 0
Form6.text3(i).Enabled = 0
Form6.text2(i).Enabled = 0
Next i
Form6.Text1(0).Visible = 1
Form6.Text1(2).Visible = 1
Form30.Option3.Value = False
'Form30.Option4.Value = False
Form30.Option5.Value = False
'Form30.Option6.Value = False
Form30.Option7.Value = False
'Form30.Option8.Value = False
Form30.Option9.Value = False
Form7.Label1.Visible = 1
Form7.label2.Visible = 1
Form7.Label3(2).Visible = 0
For i = 0 To 3
Form7.Label4(i).Visible = 0
Next i
Form7.Command5.Visible = 0
'-------------------
' Signs, Signals
Form8.text2(4).Visible = 1
Form8.text3(5).Visible = 0
Form8.Label3(5).Visible = 0
For j = 0 To 5
Form8.Text4(j).Visible = 1
Next j
Form8.text3(4).Visible = 0
For i = 0 To 3
Form8.Frame1(i).Visible = 1
Form8.text3(i).Visible = 0
Form8.text3(i).Enabled = 0
Form8.text2(i).Enabled = 0
Next i
Form8.Label1.Visible = 1
Form8.label2.Visible = 1
Form8.Label3(4).Visible = 0
For i = 0 To 5
Form8.Label4(i).Visible = 0
Next i
Form8.Command5.Visible = 0
'-------------------
' Electrical Equipment
Form17.text2(4).Visible = 1
Form17.text3(5).Visible = 0
Form17.Label3(5).Visible = 0
For j = 0 To 5
Form17.Text4(j).Visible = 1
Next j
Form17.text3(4).Visible = 0
For i = 0 To 3
Form17.Frame1(i).Visible = 1
Form17.text3(i).Visible = 0
Form17.text3(i).Enabled = 0
Form17.text2(i).Enabled = 0
Next i
Form17.Label1.Visible = 1
Form17.label2.Visible = 1
Form17.Label3(4).Visible = 0
For i = 0 To 5
Form17.Label4(i).Visible = 0
Next i
Form17.Command5.Visible = 0
'-------------------
' Personal Protective Equipment
Form19.text3(3).Visible = 0
Form19.Label3(3).Visible = 0
```

PC-BASED EVALUATION TOOL CODES

```
Form6.Label1.Visible = 1
Form6.label2.Visible = 1
Form6.Label3(5).Visible = 0
Form6.text3(6).Visible = 0
Form6.Label3(6).Visible = 0
For i = 0 To 6
Form6.Label4(i).Visible = 0
Next i
Form6.Command5.Visible = 0
'-------------------------
'Emergency/Disaster
Form7.text2(2).Visible = 1
Form7.text3(3).Visible = 0
Form7.Label3(3).Visible = 0
For j = 0 To 3
Form7.Text4(j).Visible = 1
Next j
Form7.text3(2).Visible = 0
For i = 0 To 1
Form7.Frame1(i).Visible = 1
Form7.text3(i).Visible = 0
Form7.text3(i).Enabled = 0
Form7.text2(i).Enabled = 0
Form7.Text1(i).Visible = 1
Next i
' Materials Handling, Storage and Use
Form12.text2(4).Visible = 1
Form12.text3(5).Visible = 0
Form12.Label3(5).Visible = 0
For j = 0 To 5
Form12.Text4(j).Visible = 1
Next j
Form12.text3(4).Visible = 0
For i = 0 To 3
Form12.Frame1(i).Visible = 1
Form12.text3(i).Visible = 0
Form12.text3(i).Enabled = 0
Form12.text2(i).Enabled = 0
Next i
Form12.Label1.Visible = 1
Form12.label2.Visible = 1
Form12.Label3(4).Visible = 0
For i = 0 To 5
Form12.Label4(i).Visible = 0
Next i
Form12.Command5.Visible = 0
'-------------------------
' Welding and Cutting
Form13.text2(5).Visible = 1
Form13.text3(6).Visible = 0
Form13.Label3(6).Visible = 0
For j = 0 To 3
Form13.Text4(j).Visible = 1
Next j
Form13.text3(5).Visible = 0
For i = 0 To 4
Form13.Frame1(i).Visible = 1
Form13.text3(i).Visible = 0
Form13.text3(i).Enabled = 0
Form13.text2(i).Enabled = 0
Next i
Form13.Text1(0).Visible = 1
Form19.text2(3).Visible = 1
Form19.text3(4).Visible = 0
Form19.Label3(4).Visible = 0
For i = 0 To 2
Form19.Frame1(i).Visible = 1
Form19.text3(i).Visible = 0
Form19.text3(i).Enabled = 0
Form19.text2(i).Enabled = 0
Form19.Text4(i).Visible = 1
Form19.Text4(i + 3).Visible = 1
Form19.Label3(i).Visible = 0
Next i
Form19.Label1.Visible = 1
Form19.label2.Visible = 1
For i = 0 To 4
Form19.Label4(i).Visible = 0
Next i
Form19.Command5.Visible = 0
'-------------------------

Next j
Form15.text3(5).Visible = 0
For i = 0 To 4
Form15.Frame1(i).Visible = 1
Form15.text3(i).Visible = 0
Form15.text3(i).Enabled = 0
Form15.text2(i).Enabled = 0
Next i
Form15.Text1(0).Visible = 1
Form15.Text1(2).Visible = 1
Form15.Label1.Visible = 1
Form15.label2.Visible = 1
Form15.Label3(5).Visible = 0
For i = 0 To 6
Form15.Label4(i).Visible = 0
Next i
Form15.Command5.Visible = 0
'-------------------------
' Chemical Handling
Form16.text2(3).Visible = 1
Form16.text3(4).Visible = 0
Form16.Label3(4).Visible = 0
Form16.text3(3).Visible = 0
Form16.Label3(3).Visible = 0
For i = 0 To 2
Form16.Frame1(i).Visible = 1
Form16.text3(i).Visible = 0
Form16.text3(i).Enabled = 0
Form16.text2(i).Enabled = 0
Form16.Text4(i).Visible = 1
Form16.Text4(i + 3).Visible = 1
Form16.Label3(i).Visible = 0
Next i
Form16.Label1.Visible = 1
Form16.label2.Visible = 1
For i = 0 To 4
Form16.Label4(i).Visible = 0
Next i
Form16.Command5.Visible = 0
'-------------------------
' Handling, Transportation & Disposal of
Hazardous Material and Waste
```

PC-BASED EVALUATION TOOL CODES

```
Form13.Text1(2).Visible = 1
Form13.Label1.Visible = 1
Form13.label2.Visible = 1
Form13.Label3(5).Visible = 0
For i = 0 To 6
Form13.Label4(i).Visible = 0
Next i
Form13.Command5.Visible = 0
'-----------------------
' Concrete & Concrete Formworks
Form14.text2(5).Visible = 1
Form14.text3(6).Visible = 0
Form14.Label3(6).Visible = 0
For j = 0 To 3
Form14.Text4(j).Visible = 1
Next j
Form14.text3(5).Visible = 0
For i = 0 To 4
Form14.Frame1(i).Visible = 1
Form14.text3(i).Visible = 0
Form14.text3(i).Enabled = 0
Form14.text2(i).Enabled = 0
Next i
Form14.Text1(0).Visible = 1
Form14.Text1(2).Visible = 1
Form14.Label1.Visible = 1
Form14.label2.Visible = 1
Form14.Label3(5).Visible = 0
For i = 0 To 6
Form14.Label4(i).Visible = 0
Next i
Form14.Command5.Visible = 0
'-----------------------
' Crane and Lifting Equipment
Form15.text2(5).Visible = 1
Form15.text3(6).Visible = 0
Form15.Label3(6).Visible = 0
For j = 0 To 3
Form15.Text4(j).Visible = 1
Next i
Form20.Text1(0).Visible = 1
Form20.Text1(2).Visible = 1
Form20.Label1.Visible = 1
Form20.label2.Visible = 1
Form20.Label3(5).Visible = 0
For i = 0 To 6
Form20.Label4(i).Visible = 0
Next i
Form20.Command5.Visible = 0
'-----------------------
' Transportation
Form21.text3(6).Visible = 0
Form21.Label3(6).Visible = 0
Form21.text2(5).Visible = 1
For j = 0 To 3
Form21.Text4(j).Visible = 1
Next j
Form21.text3(5).Visible = 0
For i = 0 To 4
Form21.Frame1(i).Visible = 1
Form21.text3(i).Visible = 0
Form21.text3(i).Enabled = 0
Form18.text2(3).Visible = 1
Form18.text3(3).Visible = 0
Form18.Label3(3).Visible = 0
Form18.text3(4).Visible = 0
Form18.Label3(4).Visible = 0
For i = 0 To 2
Form18.Frame1(i).Visible = 1
Form18.text3(i).Visible = 0
Form18.text3(i).Enabled = 0
Form18.text2(i).Enabled = 0
Form18.Text4(i).Visible = 1
Form18.Text4(i + 3).Visible = 1
Form18.Label3(i).Visible = 0
Next i
Form18.Label1.Visible = 1
Form18.label2.Visible = 1
For i = 0 To 4
Form18.Label4(i).Visible = 0
Next i
Form18.Command5.Visible = 0
'-----------------------
' Fire Prevention
Form20.text3(6).Visible = 0
Form20.Label3(6).Visible = 0
Form20.text2(5).Visible = 1
For j = 0 To 3
Form20.Text4(j).Visible = 1
Next j
Form20.text3(5).Visible = 0
For i = 0 To 4
Form20.Frame1(i).Visible = 1
Form20.text3(i).Visible = 0
Form20.text3(i).Enabled = 0
Form20.text2(i).Enabled = 0
Next i
Form24.Command5.Visible = 0
'-----------------------
' Mechanical Equipment
Form25.text2(3).Visible = 1
Form25.text3(3).Visible = 0
Form25.Label3(3).Visible = 0
Form25.text3(4).Visible = 0
Form25.Label3(4).Visible = 0
For i = 0 To 2
Form25.Frame1(i).Visible = 1
Form25.text3(i).Visible = 0
Form25.text3(i).Enabled = 0
Form25.text2(i).Enabled = 0
Form25.Text4(i).Visible = 1
Form25.Text4(i + 3).Visible = 1
Form25.Label3(i).Visible = 0
Next i
Form25.Label1.Visible = 1
Form25.label2.Visible = 1
For i = 0 To 4
Form25.Label4(i).Visible = 0
Next i
Form25.Command5.Visible = 0
'-----------------------
' Ionizing Radiation
Form26.text2(5).Visible = 1
For j = 0 To 3
```

```
Form21.text2(i).Enabled = 0
Next i
Form21.Text1(0).Visible = 1
Form21.Text1(2).Visible = 1
Form21.Label1.Visible = 1
Form21.label2.Visible = 1
Form21.Label3(5).Visible = 0
For i = 0 To 6
Form21.Label4(i).Visible = 0
Next i
Form21.Command5.Visible = 0
'-------------------------
' Excavation, Trenching and Shoring
Form22.text2(3).Visible = 1
Form22.text3(4).Visible = 0
Form22.Label3(4).Visible = 0
Form22.text3(3).Visible = 0
Form22.Label3(3).Visible = 0
For i = 0 To 2
Form22.Frame1(i).Visible = 1
Form22.text3(i).Visible = 0
Form22.text3(i).Enabled = 0
Form22.text2(i).Enabled = 0
Form22.Text4(i).Visible = 1
Form22.Text4(i + 3).Visible = 1
Form22.Label3(i).Visible = 0
Next i
Form22.Label1.Visible = 1
Form22.label2.Visible = 1
For i = 0 To 4
Form22.Label4(i).Visible = 0
Next i
Form22.Command5.Visible = 0
'-------------------------
' Hand and Power Tools
Form24.text2(3).Visible = 1
Form24.text3(3).Visible = 0
Form24.Label3(3).Visible = 0
Form24.text3(4).Visible = 0
Form24.Label3(4).Visible = 0
For i = 0 To 2
Form24.Frame1(i).Visible = 1
Form24.text3(i).Visible = 0
Form24.text3(i).Enabled = 0
Form24.text2(i).Enabled = 0
Form24.Text4(i).Visible = 1
Form24.Text4(i + 3).Visible = 1
Form24.Label3(i).Visible = 0
Next i
Form24.Label1.Visible = 1
Form24.label2.Visible = 1
For i = 0 To 4
Form24.Label4(i).Visible = 0
For j = 0 To 3
Form27.Text4(j).Visible = 1
Next j
Form27.text3(6).Visible = 0
For i = 0 To 5
Form27.Frame1(i).Visible = 1
Form27.text3(i).Visible = 0
Form27.text3(i).Enabled = 0
Form27.text2(i).Enabled = 0
Form26.Text4(j).Visible = 1
Next j
Form26.text3(5).Visible = 0
Form26.text3(6).Visible = 0
Form26.Label3(6).Visible = 0
For i = 0 To 4
Form26.Frame1(i).Visible = 1
Form26.text3(i).Visible = 0
Form26.text3(i).Enabled = 0
Form26.text2(i).Enabled = 0
Next i
Form26.Text1(0).Visible = 1
Form26.Text1(2).Visible = 1
Form26.Label1.Visible = 1
Form26.label2.Visible = 1
Form26.Label3(5).Visible = 0
For i = 0 To 6
Form26.Label4(i).Visible = 0
Next i
Form26.Command5.Visible = 0
'-------------------------
' Scaffolding and Ladders
Form23.text2(4).Visible = 1
For j = 0 To 5
Form23.Text4(j).Visible = 1
Next j
Form23.text3(4).Visible = 0
Form23.text3(5).Visible = 0
Form23.Label3(5).Visible = 0
For i = 0 To 3
Form23.Frame1(i).Visible = 1
Form23.text3(i).Visible = 0
Form23.text3(i).Enabled = 0
Form23.text2(i).Enabled = 0
Next i
Form23.Label1.Visible = 1
Form23.label2.Visible = 1
Form23.Label3(4).Visible = 0
For i = 0 To 5
Form23.Label4(i).Visible = 0
Next i
Form23.Command5.Visible = 0
'-------------------------
' Management Involvement-1
Form27.text3(7).Visible = 0
Form27.Label3(7).Visible = 0
Form27.text2(6).Visible = 1

Form5.text3(i).Visible = 1
Form5.text3(i).Enabled = 1
Form5.text2(i).Enabled = 1
Form5.Text4(i).Visible = 0
Form5.Text4(i + 3).Visible = 0
Form5.Label3(i).Visible = 1
Next i
Form5.Label1.Visible = 0
Form5.label2.Visible = 0
For i = 0 To 4
Form5.Label4(i).Visible = 1
Next i
Form5.Command5.Visible = 1
'-------------------------
```

```
Next i
Form27.Text1(0).Visible = 1
Form27.Text1(2).Visible = 1
Form27.Label1.Visible = 1
Form27.label2.Visible = 1
Form27.Label3(6).Visible = 0
For i = 0 To 7
Form27.Label4(i).Visible = 0
Next i
Form27.Command5.Visible = 0
'-------------------------
' Management Involvement-2
Form28.text2(5).Visible = 1
Form28.text3(6).Visible = 0
Form28.Label3(6).Visible = 0
For j = 0 To 3
Form28.Text4(j).Visible = 1
Next j
Form28.text3(5).Visible = 0
For i = 0 To 4
Form28.Frame1(i).Visible = 1
Form28.text3(i).Visible = 0
Form28.text3(i).Enabled = 0
Form28.text2(i).Enabled = 0
Next i
Form28.Text1(0).Visible = 1
Form28.Text1(2).Visible = 1
Form28.Label1.Visible = 1
Form28.label2.Visible = 1
Form28.Label3(5).Visible = 0
For i = 0 To 6
Form28.Label4(i).Visible = 0
Next i
Form28.Command5.Visible = 0
'-------------------------
End Sub
Private Sub Command3_Click()
Form51.Show
End Sub
Private Sub Command4_Click()
Form2.Hide
Private Sub Command3_Click()
Form51.Show
End Sub
Private Sub Command4_Click()
Form2.Hide
Form54.Show
'Form4.Show
For i = 0 To 4
Form4.text2(i).Enabled = 1
Form4.label2(i).Visible = 0
Form29.text2(i).Enabled = 1
Form29.label2(i).Visible = 0
Form30.text2(i).Enabled = 1
Form30.label2(i).Visible = 0
Form31.text2(i).Enabled = 1
Form31.label2(i).Visible = 0
Next i
'-------------------
' Site Planning & Housing
Form5.text3(3).Visible = 1
Form5.Label3(3).Visible = 1
'If Form4.Option2.Value = True Then
'Form4.label2(0).Caption = 0
'End If
'Form5.Label3(3).Caption = 0
'ElseIf Form5.Label3(3).Caption = sp(3)
'End If
'-------------------
' Welfare Facilities
For j = 0 To 3
Form6.Text4(j).Visible = 0
Next j
Form6.text3(5).Visible = 1
Form6.text2(5).Visible = 1
Form6.text3(6).Visible = 1
Form6.Label3(6).Visible = 1
For i = 0 To 4
Form6.Frame1(i).Visible = 0
Form6.text3(i).Visible = 1
Form6.text3(i).Enabled = 1
Form6.text2(i).Enabled = 1
Next i
Form6.Text1(0).Visible = 0
Form6.Text1(2).Visible = 0
Form6.Label1.Visible = 0
Form6.label2.Visible = 0
Form6.Label3(5).Visible = 1
For i = 0 To 6
Form6.Label4(i).Visible = 1
Next i
Form6.Command5.Visible = 1
'-------------------------
'Emergency/Disaster
For j = 0 To 3
Form7.Text4(j).Visible = 0
Next j
Form7.text3(2).Visible = 1
Form7.text2(2).Visible = 1
Form7.text3(3).Visible = 1
Form7.Label3(3).Visible = 1
For i = 0 To 1
Form7.Frame1(i).Visible = 0
Form7.text3(i).Visible = 1
Form7.text3(i).Enabled = 1
Form7.text2(i).Enabled = 1
Form7.Text1(i).Visible = 0
Next i
Form7.Label1.Visible = 0
Form7.label2.Visible = 0
Form7.Label3(2).Visible = 1
For i = 0 To 3
Form7.Label4(i).Visible = 1
Next i
Form7.Command5.Visible = 1
'-------------------------
' Signs, Signals
For j = 0 To 5
Form8.Text4(j).Visible = 0
Next j
Form8.text3(4).Visible = 1
Form8.text2(4).Visible = 1
Form8.text3(5).Visible = 1
Form8.Label3(5).Visible = 1
```

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```
Form5.text2(3).Visible = 1
Form5.text3(4).Visible = 1
Form5.Label3(4).Visible = 1
For i = 0 To 2
Form5.Frame1(i).Visible = 0
For i = 0 To 3
Form8.Frame1(i).Visible = 0
Form8.text3(i).Visible = 1
Form8.text3(i).Enabled = 1
Form8.text2(i).Enabled = 1
Next i
Form8.Label1.Visible = 0
Form8.label2.Visible = 0
Form8.Label3(4).Visible = 1
For i = 0 To 5
Form8.Label4(i).Visible = 1
Next i
Form8.Command5.Visible = 1
'-------------------------
' Electrical Equipment
For j = 0 To 5
Form17.Text4(j).Visible = 0
Next j
Form17.text3(4).Visible = 1
Form17.text2(4).Visible = 1
Form17.text3(5).Visible = 1
Form17.Label3(5).Visible = 1
For i = 0 To 3
Form17.Frame1(i).Visible = 0
Form17.text3(i).Visible = 1
Form17.text3(i).Enabled = 1
Form17.text2(i).Enabled = 1
Next i
Form17.Label1.Visible = 0
Form17.label2.Visible = 0
Form17.Label3(4).Visible = 1
For i = 0 To 5
Form17.Label4(i).Visible = 1
Next i
Form17.Command5.Visible = 1
'-------------------------
' Personal Protective Equipment
Form19.text3(3).Visible = 1
Form19.Label3(3).Visible = 1
Form19.text2(3).Visible = 1
Form19.text3(4).Visible = 1
Form19.Label3(4).Visible = 1
For i = 0 To 2
Form19.Frame1(i).Visible = 0
Form19.text3(i).Visible = 1
Form19.text3(i).Enabled = 1
Form19.text2(i).Enabled = 1
Form19.Text4(i).Visible = 0
Form19.Text4(i + 3).Visible = 0
Form19.Label3(i).Visible = 1
Next i
Form19.Label1.Visible = 0
Form19.label2.Visible = 0
For i = 0 To 4
Form19.Label4(i).Visible = 1
Next i
Form19.Command5.Visible = 1
Form12.Label4(i).Visible = 1
Next i
Form12.Command5.Visible = 1
'-------------------------
' Welding and Cutting
For j = 0 To 3
Form13.Text4(j).Visible = 0
Next j
Form13.text3(5).Visible = 1
Form13.text2(5).Visible = 1
Form13.text3(6).Visible = 1
Form13.Label3(6).Visible = 1
For i = 0 To 4
Form13.Frame1(i).Visible = 0
Form13.text3(i).Visible = 1
Form13.text3(i).Enabled = 1
Form13.text2(i).Enabled = 1
Next i
Form13.Text1(0).Visible = 0
Form13.Text1(2).Visible = 0
Form13.Label1.Visible = 0
Form13.label2.Visible = 0
Form13.Label3(5).Visible = 1
For i = 0 To 6
Form13.Label4(i).Visible = 1
Next i
Form13.Command5.Visible = 1
'-------------------------
' Concrete & Concrete Formworks
For j = 0 To 3
Form14.Text4(j).Visible = 0
Next j
Form14.text3(5).Visible = 1
Form14.text2(5).Visible = 1
Form14.text3(6).Visible = 1
Form14.Label3(6).Visible = 1
For i = 0 To 4
Form14.Frame1(i).Visible = 0
Form14.text3(i).Visible = 1
Form14.text3(i).Enabled = 1
Form14.text2(i).Enabled = 1
Next i
Form14.Text1(0).Visible = 0
Form14.Text1(2).Visible = 0
Form14.Label1.Visible = 0
Form14.label2.Visible = 0
Form14.Label3(5).Visible = 1
For i = 0 To 6
Form14.Label4(i).Visible = 1
Next i
Form14.Command5.Visible = 1
'-------------------------
' Crane and Lifting Equipment
For j = 0 To 3
Form15.Text4(j).Visible = 0
Next j
Form15.text3(5).Visible = 1
Form15.text2(5).Visible = 1
Form15.text3(6).Visible = 1
Form15.Label3(6).Visible = 1
For i = 0 To 4
Form15.Frame1(i).Visible = 0
```

```
'-------------------------
' Materials Handling, Storage and Use
For j = 0 To 5
Form12.Text4(j).Visible = 0
Next j
Form12.text3(4).Visible = 1
Form12.text2(4).Visible = 1
Form12.text3(5).Visible = 1
Form12.Label3(5).Visible = 1
For i = 0 To 3
Form12.Frame1(i).Visible = 0
Form12.text3(i).Visible = 1
Form12.text3(i).Enabled = 1
Form12.text2(i).Enabled = 1
Next i
Form12.Label1.Visible = 0
Form12.label2.Visible = 0
Form12.Label3(4).Visible = 1
For i = 0 To 5
' Chemical Handling
Form16.text3(3).Visible = 1
Form16.text2(3).Visible = 1
Form16.Label3(3).Visible = 1
Form16.text3(4).Visible = 1
Form16.Label3(4).Visible = 1
For i = 0 To 2
Form16.Frame1(i).Visible = 0
Form16.text3(i).Visible = 1
Form16.text3(i).Enabled = 1
Form16.text2(i).Enabled = 1
Form16.Text4(i).Visible = 0
Form16.Text4(i + 3).Visible = 0
Form16.Label3(i).Visible = 1
Next i
Form16.Label1.Visible = 0
Form16.label2.Visible = 0
For i = 0 To 4
Form16.Label4(i).Visible = 1
Next i
Form16.Command5.Visible = 1
'-------------------------
' Handling, Transportation & Disposal of
Hazardous Material and Waste
Form18.text3(3).Visible = 1
Form18.text2(3).Visible = 1
Form18.Label3(3).Visible = 1
Form18.text3(4).Visible = 1
Form18.Label3(4).Visible = 1
For i = 0 To 2
Form18.Frame1(i).Visible = 0
Form18.text3(i).Visible = 1
Form18.text3(i).Enabled = 1
Form18.text2(i).Enabled = 1
Form18.Text4(i).Visible = 0
Form18.Text4(i + 3).Visible = 0
Form18.Label3(i).Visible = 1
Next i
Form18.Label1.Visible = 0
Form18.label2.Visible = 0
For i = 0 To 4
Form18.Label4(i).Visible = 1
Next i
Form15.text3(i).Visible = 1
Form15.text3(i).Enabled = 1
Form15.text2(i).Enabled = 1
Next i
Form15.Text1(0).Visible = 0
Form15.Text1(2).Visible = 0
Form15.Label1.Visible = 0
Form15.label2.Visible = 0
Form15.Label3(5).Visible = 1
For i = 0 To 6
Form15.Label4(i).Visible = 1
Next i
Form15.Command5.Visible = 1
'-------------------------
Form21.text2(5).Visible = 1
For i = 0 To 4
Form21.Frame1(i).Visible = 0
Form21.text3(i).Visible = 1
Form21.text3(i).Enabled = 1
Form21.text2(i).Enabled = 1
Next i
Form21.Text1(0).Visible = 0
Form21.Text1(2).Visible = 0
Form21.Label1.Visible = 0
Form21.label2.Visible = 0
Form21.Label3(5).Visible = 1
For i = 0 To 6
Form21.Label4(i).Visible = 1
Next i
Form21.Command5.Visible = 1
'-------------------------
' Excavation, Trenching and Shoring
Form22.text3(4).Visible = 1
Form22.Label3(4).Visible = 1
Form22.text3(3).Visible = 1
Form22.text2(3).Visible = 1
Form22.Label3(3).Visible = 1
For i = 0 To 2
Form22.Frame1(i).Visible = 0
Form22.text3(i).Visible = 1
Form22.text3(i).Enabled = 1
Form22.text2(i).Enabled = 1
Form22.Text4(i).Visible = 0
Form22.Text4(i + 3).Visible = 0
Form22.Label3(i).Visible = 1
Next i
Form22.Label1.Visible = 0
Form22.label2.Visible = 0
For i = 0 To 4
Form22.Label4(i).Visible = 1
Next i
Form22.Command5.Visible = 1
'-------------------------
' Hand and Power Tools
Form24.text3(3).Visible = 1
Form24.text2(3).Visible = 1
Form24.text3(4).Visible = 1
Form24.Label3(4).Visible = 1
Form24.Label3(3).Visible = 1
For i = 0 To 2
Form24.Frame1(i).Visible = 0
Form24.text3(i).Visible = 1
```

PC-BASED EVALUATION TOOL CODES

```
Form18.Command5.Visible = 1
'-------------------------
' Fire Prevention
Form20.text3(6).Visible = 1
Form20.Label3(6).Visible = 1
For j = 0 To 3
Form20.Text4(j).Visible = 0
Next j
Form20.text3(5).Visible = 1
Form20.text2(5).Visible = 1
For i = 0 To 4
Form20.Frame1(i).Visible = 0
Form20.text3(i).Visible = 1
Form20.text3(i).Enabled = 1
Form20.text2(i).Enabled = 1
Next i
Form20.Text1(0).Visible = 0
Form20.Text1(2).Visible = 0
Form20.Label1.Visible = 0
Form20.label2.Visible = 0
Form20.Label3(5).Visible = 1
For i = 0 To 6
Form20.Label4(i).Visible = 1
Next i
Form20.Command5.Visible = 1
'-------------------------
' Transportation
Form21.text3(6).Visible = 1
Form21.Label3(6).Visible = 1
For j = 0 To 3
Form21.Text4(j).Visible = 0
Next j
Form21.text3(5).Visible = 1
Form25.Label1.Visible = 0
Form25.label2.Visible = 0
For i = 0 To 4
Form25.Label4(i).Visible = 1
Next i
Form25.Command5.Visible = 1
'-------------------------
' Ionizing Radiation
For j = 0 To 3
Form26.Text4(j).Visible = 0
Next j
Form26.text3(5).Visible = 1
Form26.text2(5).Visible = 1
Form26.text3(6).Visible = 1
Form26.Label3(6).Visible = 1
For i = 0 To 4
Form26.Frame1(i).Visible = 0
Form26.text3(i).Visible = 1
Form26.text3(i).Enabled = 1
Form26.text2(i).Enabled = 1
Next i
Form26.Text1(0).Visible = 0
Form26.Text1(2).Visible = 0
Form26.Label1.Visible = 0
Form26.label2.Visible = 0
Form26.Label3(5).Visible = 1
For i = 0 To 6
Form26.Label4(i).Visible = 1
Next i
Form24.text3(i).Enabled = 1
Form24.text2(i).Enabled = 1
Form24.Text4(i).Visible = 0
Form24.Text4(i + 3).Visible = 0
Form24.Label3(i).Visible = 1
Next i
Form24.Label1.Visible = 0
Form24.label2.Visible = 0
For i = 0 To 4
Form24.Label4(i).Visible = 1
Next i
Form24.Command5.Visible = 1
'-------------------------
' Mechanical Equipment
Form25.text3(3).Visible = 1
Form25.text2(3).Visible = 1
Form25.Label3(3).Visible = 1
Form25.text3(4).Visible = 1
Form25.Label3(4).Visible = 1
For i = 0 To 2
Form25.Frame1(i).Visible = 0
Form25.text3(i).Visible = 1
Form25.text3(i).Enabled = 1
Form25.text2(i).Enabled = 1
Form25.Text4(i).Visible = 0
Form25.Text4(i + 3).Visible = 0
Form25.Label3(i).Visible = 1
Next i
Form27.Label4(i).Visible = 1
Next i
Form27.Command5.Visible = 1
'-------------------------
' Management Involvement-2
For j = 0 To 3
Form28.Text4(j).Visible = 0
Next j
Form28.text3(5).Visible = 1
Form28.text2(5).Visible = 1
Form28.text3(6).Visible = 1
Form28.Label3(6).Visible = 1
For i = 0 To 4
Form28.Frame1(i).Visible = 0
Form28.text3(i).Visible = 1
Form28.text3(i).Enabled = 1
Form28.text2(i).Enabled = 1
Next i
Form28.Text1(0).Visible = 0
Form28.Text1(2).Visible = 0
Form28.Label1.Visible = 0
Form28.label2.Visible = 0
Form28.Label3(5).Visible = 1
For i = 0 To 6
Form28.Label4(i).Visible = 1
Next i
Form28.Command5.Visible = 1
'-------------------------
End Sub
Private Sub Command5_Click()
Form9.Show
Form2.Hide
End Sub
Private Sub Command6_Click()
```

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```
Form26.Command5.Visible = 1
'-------------------------------
' Scaffolding and Ladders
For j = 0 To 5
Form23.Text4(j).Visible = 0
Next j
Form23.text3(4).Visible = 1
Form23.text2(4).Visible = 1
Form23.text3(5).Visible = 1
Form23.Label3(5).Visible = 1
For i = 0 To 3
Form23.Frame1(i).Visible = 0
Form23.text3(i).Visible = 1
Form23.text3(i).Enabled = 1
Form23.text2(i).Enabled = 1
Next i
Form23.Label1.Visible = 0
Form23.label2.Visible = 0
Form23.Label3(4).Visible = 1
For i = 0 To 5
Form23.Label4(i).Visible = 1
Next i
Form23.Command5.Visible = 1
'-------------------------------
' Management Involvement-1
For j = 0 To 3
Form27.Text4(j).Visible = 0
Next j
Form27.text3(6).Visible = 1
Form27.text2(6).Visible = 1
Form27.text3(7).Visible = 1
Form27.Label3(7).Visible = 1
For i = 0 To 5
Form27.Frame1(i).Visible = 0
Form27.text3(i).Visible = 1
Form27.text3(i).Enabled = 1
Form27.text2(i).Enabled = 1
Next i
Form27.Text1(0).Visible = 0
Form27.Text1(2).Visible = 0
Form27.Label1.Visible = 0
Form27.label2.Visible = 0
Form27.Label3(6).Visible = 1
For i = 0 To 5
Form27.Label3(i).Visible = 1
Next i
For i = 0 To 7
Form31.Option7.Value = False
Form31.Option8.Value = False
Form31.Option9.Value = False
Form31.Option10.Value = False
Form3.text3.Text = ""
Form3.Text7.Text = ""
Form3.Text8.Text = ""
Form3.Text9.Text = ""
'Site Planning
For i = 0 To 11
Form5.Option3(i).Value = False
Next i
Form5.Label1.Caption = ""
Form5.label2.Caption = ""
For i = 0 To 3
'Form54 Re-set
Form54.text2.Text = ""
'Form4 Options
Form4.Option1.Value = False
Form4.Option2.Value = False
Form4.Option3.Value = False
Form4.Option4.Value = False
Form4.Option5.Value = False
Form4.Option6.Value = False
Form4.Option7.Value = False
Form4.Option8.Value = False
Form4.Option9.Value = False
Form4.Option10.Value = False
'Form29 Options
Form29.Option1.Value = False
Form29.Option2.Value = False
Form29.Option3.Value = False
Form29.Option4.Value = False
Form29.Option5.Value = False
Form29.Option6.Value = False
Form29.Option7.Value = False
Form29.Option8.Value = False
Form29.Option9.Value = False
Form29.Option10.Value = False
'Form30 Options
Form30.Option1.Value = False
Form30.Option2.Value = False
Form30.Option3.Value = False
Form30.Option4.Value = False
Form30.Option5.Value = False
Form30.Option6.Value = False
Form30.Option7.Value = False
Form30.Option8.Value = False
Form30.Option9.Value = False
Form30.Option10.Value = False
'Form31 Options
Form31.Option1.Value = False
Form31.Option2.Value = False
Form31.Option3.Value = False
Form31.Option4.Value = False
Form31.Option5.Value = False
Form31.Option6.Value = False
Form14.Label3(i).Caption = ""
Next i
'Crane and Lifting Equipment
For i = 0 To 19
Form15.Option3(i).Value = False
Next i
Form15.Label1.Caption = ""
Form15.label2.Caption = ""
For i = 0 To 5
Form15.text3(i).Text = ""
Form15.Label3(i).Caption = ""
Next i
'Chemical Handling
For i = 0 To 11
Form16.Option3(i).Value = False
Next i
Form16.Label1.Caption = ""
Form16.label2.Caption = ""
For i = 0 To 3
Form16.text3(i).Text = ""
```

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```
Form5.text3(i).Text = ""
Form5.Label3(i).Caption = ""
Next i
'Welfare Facilities
For i = 0 To 19
Form6.Option3(i).Value = False
Next i
Form6.Label1.Caption = ""
Form6.label2.Caption = ""
For i = 0 To 5
Form6.text3(i).Text = ""
Form6.Label3(i).Caption = ""
Next i
'Emergency/Disaster Planning & Preparation
For i = 0 To 7
Form7.Option3(i).Value = False
Next i
Form7.Label1.Caption = ""
Form7.label2.Caption = ""
For i = 0 To 2
Form7.text3(i).Text = ""
Form7.Label3(i).Caption = ""
Next i
'Signs, Signals & Barricades
For i = 0 To 15
Form8.Option3(i).Value = False
Next i
Form8.Label1.Caption = ""
Form8.label2.Caption = ""
For i = 0 To 4
Form8.text3(i).Text = ""
Form8.Label3(i).Caption = ""
Next i
'Materials Handling, Storage & Use
For i = 0 To 15
Form12.Option3(i).Value = False
Next i
Form12.Label1.Caption = ""
Form12.label2.Caption = ""
For i = 0 To 4
Form12.text3(i).Text = ""
Form12.Label3(i).Caption = ""
Next i
'Welding & Cutting
For i = 0 To 19
Form13.Option3(i).Value = False
Next i
Form13.Label1.Caption = ""
Form13.label2.Caption = ""
For i = 0 To 5
Form13.text3(i).Text = ""
Form13.Label3(i).Caption = ""
Next i
'Concrete and Concrete Formworks
For i = 0 To 19
Form14.Option3(i).Value = False
Next i
Form14.Label1.Caption = ""
Form14.label2.Caption = ""
For i = 0 To 5
Form14.text3(i).Text = ""
Next i
Form16.Label3(i).Caption = ""
Next i
'Electrical Equipment
For i = 0 To 15
Form17.Option3(i).Value = False
Next i
Form17.Label1.Caption = ""
Form17.label2.Caption = ""
For i = 0 To 4
Form17.text3(i).Text = ""
Form17.Label3(i).Caption = ""
Next i
'Handling, Transportation & Disposal
of Hazardous Material & Waste
For i = 0 To 11
Form18.Option3(i).Value = False
Next i
Form18.Label1.Caption = ""
Form18.label2.Caption = ""
For i = 0 To 3
Form18.text3(i).Text = ""
Form18.Label3(i).Caption = ""
Next i
'Personal Protective Equipment
For i = 0 To 11
Form19.Option3(i).Value = False
Next i
Form19.Label1.Caption = ""
Form19.label2.Caption = ""
For i = 0 To 3
Form19.text3(i).Text = ""
Form19.Label3(i).Caption = ""
Next i
'Fire Prevention
For i = 0 To 19
Form20.Option3(i).Value = False
Next i
Form20.Label1.Caption = ""
Form20.label2.Caption = ""
For i = 0 To 5
Form20.text3(i).Text = ""
Form20.Label3(i).Caption = ""
Next i
'Transportation
For i = 0 To 19
Form21.Option3(i).Value = False
Next i
Form21.Label1.Caption = ""
Form21.label2.Caption = ""
For i = 0 To 5
Form21.text3(i).Text = ""
Form21.Label3(i).Caption = ""
Next i
'Excavation, Trenching & Shoring
For i = 0 To 11
Form22.Option3(i).Value = False
Private Sub Command7_Click()
Cls
Form1.Show
End Sub
Private Sub Command8_Click()
End
```

PC-BASED EVALUATION TOOL CODES

```
Form22.Label1.Caption = ""
Form22.label2.Caption = ""
For i = 0 To 3
Form22.text3(i).Text = ""
Form22.Label3(i).Caption = ""
Next i
'Scaffolding and Ladders
For i = 0 To 15
Form23.Option3(i).Value = False
Next i
Form23.Label1.Caption = ""
Form23.label2.Caption = ""
For i = 0 To 4
Form23.text3(i).Text = ""
Form23.Label3(i).Caption = ""
Next i
'Hand and Power Tools
For i = 0 To 11
Form24.Option3(i).Value = False
Next i
Form24.Label1.Caption = ""
Form24.label2.Caption = ""
For i = 0 To 3
Form24.text3(i).Text = ""
Form24.Label3(i).Caption = ""
Next i
'Mechanical Equipment
For i = 0 To 11
Form25.Option3(i).Value = False
Next i
Form25.Label1.Caption = ""
Form25.label2.Caption = ""
For i = 0 To 3
Form25.text3(i).Text = ""
Form25.Label3(i).Caption = ""
Next i
'Ionization Radiation
For i = 0 To 19
Form26.Option3(i).Value = False
Next i
Form26.Label1.Caption = ""
Form26.label2.Caption = ""
For i = 0 To 5
Form26.text3(i).Text = ""
Form26.Label3(i).Caption = ""
Next i
'Management Involvement - 1
For i = 0 To 23
Form27.Option3(i).Value = False
Next i
Form27.Label1.Caption = ""
Form27.label2.Caption = ""
For i = 0 To 6
Form27.text3(i).Text = ""
Form27.Label3(i).Caption = ""
Next i
'Management Involvement - 2
For i = 0 To 19
Form28.Option3(i).Value = False
Next i
Form28.Label1.Caption = ""
Form28.label2.Caption = ""
End Sub
Private Sub Form_Load()
'PC-Based Evaluation Tool Main Menu
End Sub

FORM-20
Public Sub updatelabel()
'Fire Prevention
Dim wf(6)
wf(5) = 0.52
wf(0) = 0.23
wf(1) = 0.19
wf(2) = 0.21
wf(3) = 0.2
wf(4) = 0.17
For i = 0 To 5
If Form20.text3(i).Text <> "" Then
wf(i) = Form20.Label3(i).Caption
Else
Form20.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 19 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form20.Label3(5).Caption
Form30.label2(2).Caption = wwf *
Form20.Label3(5).Caption
End Sub
Private Sub Command1_Click()
Form30.Show
Form20.Hide
Form30.Option13.Value = False
Form30.Option6.Value = False
'For j = 0 To 3
'Form20.Text4(j).Visible = 1
'Next j
'Form20.Text3(5).Visible = 0
'For i = 0 To 4
'Form20.Frame1(i).Visible = 1
'Form20.Text3(i).Visible = 0
'Form20.Text3(i).Enabled = 0
'Form20.text2(i).Enabled = 0
'Next i
'Form20.Text1(0).Visible = 1
'Form20.Text1(2).Visible = 1
'Form20.Label1.Visible = 1
'Form20.label2.Visible = 1
'Form20.Label3(5).Visible = 0
End Sub
```

PC-BASED EVALUATION TOOL CODES

```
For i = 0 To 5
Form28.text3(i).Text = ""
Form28.Label3(i).Caption = ""
Next i
For i = 0 To 4
Form4.label2(i).Caption = ""
Form29.label2(i).Caption = ""
Form30.label2(i).Caption = ""
Form31.label2(i).Caption = ""
Next i
Form3.Show
Form2.Hide
End Sub
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 4
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 5
Form20.Label3(i).Caption = Form20.text3(i).Text
Next i
Else
For i = 0 To 4
Form20.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 5
'Form20.Label3(i).Caption =
Form20.Text3(i).Text
'Next i
End Sub
```

FORM-21

```
Public Sub updatelabel()
'Transportation
Dim wf(6)
wf(5) = 0.48
wf(0) = 0.19
wf(1) = 0.19
wf(2) = 0.19
wf(3) = 0.22
wf(4) = 0.21
For i = 0 To 5
If Form21.text3(i).Text <> "" Then
wf(i) = Form21.Label3(i).Caption
Else
Form21.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 19 Step 4
Private Sub Command2_Click()
Form42.Show
Form20.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form20.Hide
End Sub
Private Sub Command4_Click()
'For i = 0 To 4
'Form21.Frame1(i).Visible = 1
'Form21.Text3(i).Visible = 0
'Form21.Text3(i).Enabled = 0
'Form21.text2(i).Enabled = 0
'Next i
'Form21.Text1(0).Visible = 1
'Form21.Text1(2).Visible = 1
'Form21.Label1.Visible = 1
'Form21.label2.Visible = 1
'Form21.Label3(5).Visible = 0
End Sub
Private Sub Command3_Click()
Form2.Show
Form21.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 4
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 5
Form21.Label3(i).Caption = Form21.text3(i).Text
Next i
Else
For i = 0 To 4
Form21.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 5
'Form21.Label3(i).Caption = Form21.Text3(i).Text
'Next i
End Sub
```

FORM-22

```
Public Sub updatelabel()
'Excavation, Trenching and Shoring
Dim wf(4)
wf(3) = 0.5
```

```
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form21.Label3(5).Caption
Form30.label2(3).Caption = wwf *
Form21.Label3(5).Caption
End Sub
Private Sub Command1_Click()
Form30.Show
Form21.Hide
Form30.Option14.Value = False
Form30.Option8.Value = False
End Sub
Private Sub Command2_Click()
Form43.Show
Form21.Hide
'For j = 0 To 3
'Form21.Text4(j).Visible = 1
'Next j
'Form21.Text3(5).Visible = 0
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form22.Label3(3).Caption
Form30.label2(4).Caption = wwf *
Form22.Label3(3).Caption
End Sub
Private Sub Command1_Click()
Form30.Show
Form22.Hide
Form30.Option15.Value = False
Form30.Option10.Value = False
End Sub
Private Sub Command2_Click()
Form44.Show
Form22.Hide
'Form22.Text3(3).Visible = 0
'Form22.Label3(3).Visible = 0
'For i = 0 To 2
'Form22.Frame1(i).Visible = 1
'Form22.Text3(i).Visible = 0
'Form22.Text3(i).Enabled = 0
'Form22.text2(i).Enabled = 0
'Form22.Text4(i).Visible = 1
'Form22.Text4(i + 3).Visible = 1
'Form22.Label3(i).Visible = 0
'Next i
'Form22.Label1.Visible = 1
'Form22.label2.Visible = 1
End Sub
Private Sub Command3_Click()
Form2.Show
Form22.Hide
End Sub
```

```
wf(0) = 0.39
wf(1) = 0.26
wf(2) = 0.35
For i = 0 To 3
If Form22.text3(i).Text <> "" Then
wf(i) = Form22.Label3(i).Caption
Else
Form22.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 11 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
wf(1) = 0.25
wf(2) = 0.24
wf(3) = 0.26
For i = 0 To 4
If Form23.text3(i).Text <> "" Then
wf(i) = Form23.Label3(i).Caption
Else
Form23.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 15 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form23.Label3(4).Caption
Form31.label2(0).Caption = wwf *
Form23.Label3(4).Caption
End Sub
Private Sub Command1_Click()
Form31.Show
Form23.Hide
Form31.Option11.Value = False
Form31.Option2.Value = False
'For j = 0 To 5
'Form23.Text4(j).Visible = 1
'Next j
'Form23.Text3(4).Visible = 0
'For i = 0 To 3
```

PC-BASED EVALUATION TOOL CODES

```
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 2
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 3
Form22.Label3(i).Caption = Form22.text3(i).Text
Next i
Else
For i = 0 To 2
Form22.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 3
'Form22.Label3(i).Caption =
Form22.Text3(i).Text
'Next i
End Sub
```

FORM-23

```
Public Sub updatelabel()
'Scaffolding and Ladders
Dim wf(5)
wf(4) = 0.56
wf(0) = 0.25

Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 3
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 4
Form23.Label3(i).Caption = Form23.text3(i).Text
Next i
Else
For i = 0 To 3
Form23.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
'Form23.Frame1(i).Visible = 1
'Form23.Text3(i).Visible = 0
'Form23.Text3(i).Enabled = 0
'Form23.text2(i).Enabled = 0
'Next i
'Form23.Label1.Visible = 1
'Form23.label2.Visible = 1
'Form23.Label3(4).Visible = 0
End Sub
Private Sub Command2_Click()
Form45.Show
Form23.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form23.Hide
End Sub
Form31.label2(1).Caption = wwf *
Form24.Label3(3).Caption
End Sub
Private Sub Command1_Click()
Form31.Show
Form24.Hide
Form31.Option12.Value = False
Form31.Option4.Value = False
'Form24.Text3(3).Visible = 0
'Form24.Label3(3).Visible = 0
'For i = 0 To 2
'Form24.Frame1(i).Visible = 1
'Form24.Text3(i).Visible = 0
'Form24.Text3(i).Enabled = 0
'Form24.text2(i).Enabled = 0
'Form24.Text4(i).Visible = 1
'Form24.Text4(i + 3).Visible = 1
'Form24.Label3(i).Visible = 0
'Next i
'Form24.Label1.Visible = 1
'Form24.label2.Visible = 1
End Sub
Private Sub Command2_Click()
Form46.Show
Form24.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form24.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 2
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 3
Form24.Label3(i).Caption = Form24.text3(i).Text
Next i
Else
For i = 0 To 2
```

```
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 4
'Form23.Label3(i).Caption =
Form23.Text3(i).Text
'Next i
End Sub
```

FORM-24

```
Public Sub updatelabel()
'Hand and Power Tools
Dim wf(4)
wf(3) = 0.38
wf(0) = 0.37
wf(1) = 0.31
wf(2) = 0.32
For i = 0 To 3
If Form24.text3(i).Text <> "" Then
wf(i) = Form24.Label3(i).Caption
Else
Form24.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 11 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form24.Label3(3).Caption
'option
For i = 0 To 11 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form25.Label3(3).Caption
Form31.label2(2).Caption = wwf *
Form25.Label3(3).Caption
End Sub
Private Sub Command1_Click()
Form31.Show
Form24.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 3
'Form24.Label3(i).Caption = Form24.Text3(i).Text
'Next i
End Sub
```

FORM-25

```
Public Sub updatelabel()
'Mechanical Equipment
Dim wf(4)
wf(3) = 0.5
wf(0) = 0.35
wf(1) = 0.36
wf(2) = 0.29
For i = 0 To 3
If Form25.text3(i).Text <> "" Then
wf(i) = Form25.Label3(i).Caption
Else
Form25.Label3(i).Caption = wf(i)
End If
Next i
j = 0
```

FORM-26

```
Public Sub updatelabel()
'Ionization Radiation
Dim wf(6)
wf(5) = 0.57
wf(0) = 0.21
wf(1) = 0.21
wf(2) = 0.2
wf(3) = 0.19
wf(4) = 0.19
For i = 0 To 5
If Form26.text3(i).Text <> "" Then
wf(i) = Form26.Label3(i).Caption
Else
Form26.Label3(i).Caption = wf(i)
End If
Next i
j = 0
'option
For i = 0 To 19 Step 4
If Option3(i).Value = True Then
wwf = wf(j) * 10 + wwf
ElseIf Option3(i + 1).Value = True Then
wwf = wf(j) * 7 + wwf
ElseIf Option3(i + 2).Value = True Then
wwf = wf(j) * 5 + wwf
ElseIf Option3(i + 3).Value = True Then
wwf = wf(j) * 1 + wwf
End If
```

```
Form25.Hide
Form31.Option13.Value = False
Form31.Option6.Value = False
'Form25.Text3(3).Visible = 0
'Form25.Label3(3).Visible = 0
'For i = 0 To 2
'Form25.Frame1(i).Visible = 1
'Form25.Text3(i).Visible = 0
'Form25.Text3(i).Enabled = 0
'Form25.text2(i).Enabled = 0
'Form25.Text4(i).Visible = 1
'Form25.Text4(i + 3).Visible = 1
'Form25.Label3(i).Visible = 0
'Next i
'Form25.Label1.Visible = 1
'Form25.label2.Visible = 1
End Sub
Private Sub Command2_Click()
Form47.Show
Form25.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form25.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 2
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 3
Form25.Label3(i).Caption = Form25.text3(i).Text
Next i
Else
For i = 0 To 2
Form25.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 3
'Form25.Label3(i).Caption =
Form25.Text3(i).Text
'Next i
End Sub

Next i
Else
For i = 0 To 4
Form26.Label3(i).Caption = "Error"
j = j + 1
Next i
Label1.Caption = wwf
label2.Caption = wwf * Form26.Label3(5).Caption
Form31.label2(3).Caption = wwf *
Form26.Label3(5).Caption
End Sub
Private Sub Command1_Click()
Form31.Show
Form26.Hide
Form31.Option14.Value = False
Form31.Option8.Value = False
'For j = 0 To 3
'Form26.Text4(j).Visible = 1
'Next j
'Form26.Text3(5).Visible = 0
'For i = 0 To 4
'Form26.Frame1(i).Visible = 1
'Form26.Text3(i).Visible = 0
'Form26.Text3(i).Enabled = 0
'Form26.text2(i).Enabled = 0
'Next i
'Form26.Text1(0).Visible = 1
'Form26.Text1(2).Visible = 1
'Form26.Label1.Visible = 1
'Form26.label2.Visible = 1
'Form26.Label3(5).Visible = 0
End Sub
Private Sub Command2_Click()
Form48.Show
Form26.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form26.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 4
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 5
Form26.Label3(i).Caption = Form26.text3(i).Text
'For i = 0 To 6
'Form27.Label3(i).Caption = Form27.Text3(i).Text
'Next i
End Sub

FORM-28
Private Sub Command1_Click()
Form31.Show
Form28.Hide
Form31.Option15.Value = False
Form31.Option10.Value = False
'For j = 0 To 3
'Form28.Text4(j).Visible = 1
'Next j
```

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```
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End SubPublic Sub updatelabel2()
'For i = 0 To 5
'Form26.Label3(i).Caption =
Form26.Text3(i).Text
'Next i
End Sub
```

FORM-27

```
Private Sub Command1_Click()
Form28.Show
Form27.Hide
Form31.Option15.Value = False
Form31.Option10.Value = False
'For j = 0 To 3
'Form27.Text4(j).Visible = 1
'Next j
'Form27.Text3(6).Visible = 0
'For i = 0 To 5
'Form27.Frame1(i).Visible = 1
'Form27.Text3(i).Visible = 0
'Form27.Text3(i).Enabled = 0
'Form27.text2(i).Enabled = 0
'Next i
'Form27.Text1(0).Visible = 1
'Form27.Text1(2).Visible = 1
'Form27.Label1.Visible = 1
'Form27.label2.Visible = 1
'Form27.Label3(6).Visible = 0
End Sub
Private Sub Command2_Click()
Form49.Show
Form27.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form27.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 5
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 6
Form27.Label3(i).Caption = Form27.text3(i).Text
Next i
Else
For i = 0 To 5
Form27.Label3(i).Caption = "Error"
'Form28.Text3(5).Visible = 0
'For i = 0 To 4
'Form28.Frame1(i).Visible = 1
'Form28.Text3(i).Visible = 0
'Form28.Text3(i).Enabled = 0
'Form28.text2(i).Enabled = 0
'Next i
'Form28.Text1(0).Visible = 1
'Form28.Text1(2).Visible = 1
'Form28.Label1.Visible = 1
'Form28.label2.Visible = 1
'Form28.Label3(5).Visible = 0
End Sub
Private Sub Command2_Click()
Form50.Show
Form28.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form28.Hide
End Sub
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 4
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 5
Form28.Label3(i).Caption = Form28.text3(i).Text
Next i
Else
For i = 0 To 4
Form28.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 5
'Form28.Label3(i).Caption = Form28.Text3(i).Text
'Next i
End Sub
```

FORM-29

```
Private Sub Command1_Click()
'Influencing Factors:
'-------------------
'6. Welding and Cutting
'7. Concrete and Concrete Formworks
'8. Crane and Lifting Equipment
'9. Chemical Handling
'10. Electrical Equipment
```

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```
Next i
Form65.Show
End If
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
Form30.Show
Form29.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form29.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Command4_Click()
Form4.Show
Form29.Hide
End Sub
Private Sub Form_Load()

'Influencing Factors:
'-------------------------
'6. Welding and Cutting
'7. Concrete and Concrete Formworks
'8. Crane and Lifting Equipment
'9. Chemical Handling
'10. Electrical Equipment
End Sub
Private Sub Option1_Click()
Form13.Show
End Sub
Private Sub Option10_Click()
Form64.Show
Form29.Hide
Form29.label2(4).Caption = ""

Form17.Option3(0).Value = False
Form17.Option3(1).Value = False
Form17.Option3(2).Value = False
Form17.Option3(3).Value = False
Form17.Option3(4).Value = False
Form17.Option3(5).Value = False
Form17.Option3(6).Value = False
Form17.Option3(7).Value = False
Form17.Option3(8).Value = False
Form17.Option3(9).Value = False
Form17.Option3(10).Value = False
Form17.Option3(11).Value = False
Form17.Option3(12).Value = False
Form17.Option3(13).Value = False
Form17.Option3(14).Value = False
Form17.Option3(15).Value = False

Form17.Label1.Caption = ""
Form17.label2.Caption = ""
Form13.Option3(2).Value = False
Form13.Option3(3).Value = False
Form13.Option3(4).Value = False
Form13.Option3(5).Value = False
Form13.Option3(6).Value = False
Form13.Option3(7).Value = False
Form13.Option3(8).Value = False
Form13.Option3(9).Value = False
Form13.Option3(10).Value = False
Form13.Option3(11).Value = False
Form13.Option3(12).Value = False
Form13.Option3(13).Value = False
Form13.Option3(14).Value = False
Form13.Option3(15).Value = False
Form13.Option3(16).Value = False
Form13.Option3(17).Value = False
Form13.Option3(18).Value = False
Form13.Option3(19).Value = False
Form13.Label1.Caption = ""
Form13.label2.Caption = ""
End Sub
Private Sub Option3_Click()
Form14.Show
End Sub
Private Sub Option4_Click()
Form29.label2(1).Caption = ""
Form14.Option3(0).Value = False
Form14.Option3(1).Value = False
Form14.Option3(2).Value = False
Form14.Option3(3).Value = False
Form14.Option3(4).Value = False
Form14.Option3(5).Value = False
Form14.Option3(6).Value = False
Form14.Option3(7).Value = False
Form14.Option3(8).Value = False
Form14.Option3(9).Value = False
Form14.Option3(10).Value = False
Form14.Option3(11).Value = False
Form14.Option3(12).Value = False
Form14.Option3(13).Value = False
Form14.Option3(14).Value = False
Form14.Option3(15).Value = False
Form14.Option3(16).Value = False
Form14.Option3(17).Value = False
Form14.Option3(18).Value = False
Form14.Option3(19).Value = False
Form14.Label1.Caption = ""
Form14.label2.Caption = ""
End Sub
Private Sub Option5_Click()
Form15.Show
End Sub
Private Sub Option6_Click()
Form29.label2(2).Caption = ""
Form15.Option3(0).Value = False
Form15.Option3(1).Value = False
Form15.Option3(2).Value = False
Form15.Option3(3).Value = False
Form15.Option3(4).Value = False
Form15.Option3(5).Value = False
Form15.Option3(6).Value = False
Form15.Option3(7).Value = False
```

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```
End Sub
Private Sub Option11_Click()
Form13.Show
Form29.Hide
End Sub
Private Sub Option12_Click()
Form14.Show
Form29.Hide
End Sub
Private Sub Option13_Click()
Form15.Show
Form29.Hide
End Sub
Private Sub Option14_Click()
Form16.Show
Form29.Hide
End Sub
Private Sub Option15_Click()
Form17.Show
Form29.Hide
End Sub
Private Sub Option2_Click()
Form29.label2(0).Caption = ""
Form13.Option3(0).Value = False
Form13.Option3(1).Value = False
End Sub
Private Sub Option7_Click()
Form16.Show
End Sub
Private Sub Option8_Click()
Form29.label2(3).Caption = ""
Form16.Option3(0).Value = False
Form16.Option3(1).Value = False
Form16.Option3(2).Value = False
Form16.Option3(3).Value = False
Form16.Option3(4).Value = False
Form16.Option3(5).Value = False
Form16.Option3(6).Value = False
Form16.Option3(7).Value = False
Form16.Option3(8).Value = False
Form16.Option3(9).Value = False
Form16.Option3(10).Value = False
Form16.Option3(11).Value = False
Form16.Label1.Caption = ""
Form16.label2.Caption = ""
End Sub
Private Sub Option9_Click()
Form17.Show
End Sub
```

FORM-3

```
Private Sub Command1_Click()
Form2.Show
Form3.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'PC-Based Evaluation Tool Project Information
End Sub
```

FORM-30

```
Form15.Option3(8).Value = False
Form15.Option3(9).Value = False
Form15.Option3(10).Value = False
Form15.Option3(11).Value = False
Form15.Option3(12).Value = False
Form15.Option3(13).Value = False
Form15.Option3(14).Value = False
Form15.Option3(15).Value = False
Form15.Option3(16).Value = False
Form15.Option3(17).Value = False
Form15.Option3(18).Value = False
Form15.Option3(19).Value = False
Form15.Label1.Caption = ""
Form15.label2.Caption = ""
Form22.Option3(1).Value = False
Form22.Option3(2).Value = False
Form22.Option3(3).Value = False
Form22.Option3(4).Value = False
Form22.Option3(5).Value = False
Form22.Option3(6).Value = False
Form22.Option3(7).Value = False
Form22.Option3(8).Value = False
Form22.Option3(9).Value = False
Form22.Option3(10).Value = False
Form22.Option3(11).Value = False
Form22.Label1.Caption = ""
Form22.label2.Caption = ""
End Sub
Private Sub Option11_Click()
Form18.Show
Form30.Hide
End Sub
Private Sub Option12_Click()
Form19.Show
Form30.Hide
End Sub
Private Sub Option13_Click()
Form20.Show
Form30.Hide
End Sub
Private Sub Option14_Click()
Form21.Show
Form30.Hide
End Sub
Private Sub Option15_Click()
Form22.Show
Form30.Hide
End Sub
Private Sub Option2_Click()
Form30.label2(0).Caption = ""
Form18.Option3(0).Value = False
Form18.Option3(1).Value = False
Form18.Option3(2).Value = False
Form18.Option3(3).Value = False
Form18.Option3(4).Value = False
Form18.Option3(5).Value = False
Form18.Option3(6).Value = False
Form18.Option3(7).Value = False
Form18.Option3(8).Value = False
Form18.Option3(9).Value = False
Form18.Option3(10).Value = False
Form18.Option3(11).Value = False
```

PC-BASED EVALUATION TOOL CODES

```
Private Sub Command1_Click()
'Influencing Factors:
'-----------------------
'11. Handling Transportation / Disposal
    of Hazardous Material
'12. Personal Protective Equipment
'13. Fire Prevention
'14. Transportation
'15. Excavation / Trenching and Shoring
Form31.Show
Form30.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form30.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Command4_Click()
Form29.Show
Form30.Hide
End Sub
Private Sub Form_Load()
'Influencing Factors:
'-----------------------
'11. Handling Transportation / Disposal
    of Hazardous Material
'12. Personal Protective Equipment
'13. Fire Prevention
'14. Transportation
'15. Excavation / Trenching and Shoring
End Sub
Private Sub Option1_Click()
Form18.Show
End Sub
Private Sub Option10_Click()
Form30.label2(4).Caption = ""
Form22.Option3(0).Value = False
Private Sub Option6_Click()
Form62.Show
Form30.Hide
Form30.label2(2).Caption = ""
Form20.Option3(0).Value = False
Form20.Option3(1).Value = False
Form20.Option3(2).Value = False
Form20.Option3(3).Value = False
Form20.Option3(4).Value = False
Form20.Option3(5).Value = False
Form20.Option3(6).Value = False
Form20.Option3(7).Value = False
Form20.Option3(8).Value = False
Form20.Option3(9).Value = False
Form20.Option3(10).Value = False
Form20.Option3(11).Value = False
Form20.Option3(12).Value = False
Form20.Option3(13).Value = False
Form20.Option3(14).Value = False
Form20.Option3(15).Value = False
Form20.Option3(16).Value = False
Form20.Option3(17).Value = False
Form20.Option3(18).Value = False
Form18.Label1.Caption = ""
Form18.label2.Caption = ""
End Sub
Private Sub Option3_Click()
Form19.Show
End Sub
Private Sub Option4_Click()
Form55.Show
Form30.Hide
Form30.label2(1).Caption = ""
Form19.Option3(0).Value = False
Form19.Option3(1).Value = False
Form19.Option3(2).Value = False
Form19.Option3(3).Value = False
Form19.Option3(4).Value = False
Form19.Option3(5).Value = False
Form19.Option3(6).Value = False
Form19.Option3(7).Value = False
Form19.Option3(8).Value = False
Form19.Option3(9).Value = False
Form19.Option3(10).Value = False
Form19.Option3(11).Value = False
Form19.Label1.Caption = ""
Form19.label2.Caption = ""
End Sub
Private Sub Option5_Click()
Form20.Show
End Sub
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Command4_Click()
Form30.Show
Form31.Hide
End Sub
Private Sub Form_Load()
'Influencing Factors:
'-----------------------
'16. Scaffolding and Ladders
'17. Hand and Power Tools
'18. Mechanical Equipment
'19. Ionization Radiation
'20. Management Involvement
End Sub
Private Sub Option1_Click()
Form23.Show
End Sub
Private Sub Option10_Click()
Form56.Show
Form31.Hide
Form31.label2(4).Caption = ""
Form27.Option3(0).Value = False
Form27.Option3(1).Value = False
Form27.Option3(2).Value = False
Form27.Option3(3).Value = False
Form27.Option3(4).Value = False
Form27.Option3(5).Value = False
Form27.Option3(6).Value = False
Form27.Option3(7).Value = False
Form27.Option3(8).Value = False
Form27.Option3(9).Value = False
```

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```
Form20.Option3(19).Value = False
Form20.Label1.Caption = ""
Form20.label2.Caption = ""
End Sub
Private Sub Option7_Click()
Form21.Show
End Sub
Private Sub Option8_Click()
Form63.Show
Form30.Hide
Form30.label2(3).Caption = ""
Form21.Option3(0).Value = False
Form21.Option3(1).Value = False
Form21.Option3(2).Value = False
Form21.Option3(3).Value = False
Form21.Option3(4).Value = False
Form21.Option3(5).Value = False
Form21.Option3(6).Value = False
Form21.Option3(7).Value = False
Form21.Option3(8).Value = False
Form21.Option3(9).Value = False
Form21.Option3(10).Value = False
Form21.Option3(11).Value = False
Form21.Option3(12).Value = False
Form21.Option3(13).Value = False
Form21.Option3(14).Value = False
Form21.Option3(15).Value = False
Form21.Option3(16).Value = False
Form21.Option3(17).Value = False
Form21.Option3(18).Value = False
Form21.Option3(19).Value = False
Form21.Label1.Caption = ""
Form21.label2.Caption = ""
End Sub
Private Sub Option9_Click()
Form22.Show
End Sub

FORM-31
Private Sub Command1_Click()
'Influencing Factors:
'-------------------
'16. Scaffolding and Ladders
'17. Hand and Power Tools
'18. Mechanical Equipment
'19. Ionization Radiation
'20. Management Involvement
Form2.Show
Form31.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form31.Hide
End Sub
Private Sub Option12_Click()
Form24.Show
Form31.Hide
End Sub
Private Sub Option13_Click()
Form25.Show
Form31.Hide
End Sub
```

```
Form27.Option3(10).Value = False
Form27.Option3(11).Value = False
Form27.Option3(12).Value = False
Form27.Option3(13).Value = False
Form27.Option3(14).Value = False
Form27.Option3(15).Value = False
Form27.Option3(16).Value = False
Form27.Option3(17).Value = False
Form27.Option3(18).Value = False
Form27.Option3(19).Value = False
Form27.Option3(20).Value = False
Form27.Option3(21).Value = False
Form27.Option3(22).Value = False
Form27.Option3(23).Value = False
Form28.Option3(0).Value = False
Form28.Option3(1).Value = False
Form28.Option3(2).Value = False
Form28.Option3(3).Value = False
Form28.Option3(4).Value = False
Form28.Option3(5).Value = False
Form28.Option3(6).Value = False
Form28.Option3(7).Value = False
Form28.Option3(8).Value = False
Form28.Option3(9).Value = False
Form28.Option3(10).Value = False
Form28.Option3(11).Value = False
Form28.Option3(12).Value = False
Form28.Option3(13).Value = False
Form28.Option3(14).Value = False
Form28.Option3(15).Value = False
Form28.Option3(16).Value = False
Form28.Option3(17).Value = False
Form28.Option3(18).Value = False
Form28.Option3(19).Value = False
Form27.Label1.Caption = ""
Form27.label2.Caption = ""
Form28.Label1.Caption = ""
Form28.label2.Caption = ""
End Sub
Private Sub Option11_Click()
Form23.Show
Form31.Hide
Form25.label2.Caption = ""
End Sub
Private Sub Option7_Click()
Form26.Show
End Sub
Private Sub Option8_Click()
Form31.label2(3).Caption = ""
Form26.Option3(0).Value = False
Form26.Option3(1).Value = False
Form26.Option3(2).Value = False
Form26.Option3(3).Value = False
Form26.Option3(4).Value = False
Form26.Option3(5).Value = False
Form26.Option3(6).Value = False
Form26.Option3(7).Value = False
Form26.Option3(8).Value = False
Form26.Option3(9).Value = False
Form26.Option3(10).Value = False
Form26.Option3(11).Value = False
Form26.Option3(12).Value = False
```

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```
Private Sub Option14_Click()
Form26.Show
Form31.Hide
End Sub
Private Sub Option15_Click()
Form27.Show
Form31.Hide
End Sub
Private Sub Option2_Click()
Form31.label2(0).Caption = ""
Form23.Option3(0).Value = False
Form23.Option3(1).Value = False
Form23.Option3(2).Value = False
Form23.Option3(3).Value = False
Form23.Option3(4).Value = False
Form23.Option3(5).Value = False
Form23.Option3(6).Value = False
Form23.Option3(7).Value = False
Form23.Option3(8).Value = False
Form23.Option3(9).Value = False
Form23.Option3(10).Value = False
Form23.Option3(11).Value = False
Form23.Option3(12).Value = False
Form23.Option3(13).Value = False
Form23.Option3(14).Value = False
Form23.Option3(15).Value = False
Form23.Label1.Caption = ""
Form23.label2.Caption = ""
End Sub
Private Sub Option3_Click()
Form24.Show
End Sub
Private Sub Option4_Click()
Form31.label2(1).Caption = ""
Form24.Option3(0).Value = False
Form24.Option3(1).Value = False
Form24.Option3(2).Value = False
Form24.Option3(3).Value = False
Form24.Option3(4).Value = False
Form24.Option3(5).Value = False
Form24.Option3(6).Value = False
Form24.Option3(7).Value = False
Form24.Option3(8).Value = False
Form24.Option3(9).Value = False
Form24.Option3(10).Value = False
Form24.Option3(11).Value = False
Form24.Label1.Caption = ""
Form24.label2.Caption = ""
End Sub
Private Sub Option5_Click()
Form25.Show
End Sub
Private Sub Option6_Click()
Form31.label2(2).Caption = ""
Form25.Option3(0).Value = False
Form25.Option3(1).Value = False
Form25.Option3(2).Value = False
Form25.Option3(3).Value = False
Form25.Option3(4).Value = False
Form25.Option3(5).Value = False
Form25.Option3(6).Value = False
Form25.Option3(7).Value = False
Form26.Option3(13).Value = False
Form26.Option3(14).Value = False
Form26.Option3(15).Value = False
Form26.Option3(16).Value = False
Form26.Option3(17).Value = False
Form26.Option3(18).Value = False
Form26.Option3(19).Value = False
Form26.Label1.Caption = ""
Form26.label2.Caption = ""
End Sub
Private Sub Option9_Click()
Form27.Show
End Sub

FORM-32
Private Sub Command1_Click()
'Help for Emergency / Disaster Planning and
Preparation
'-----------------------------------
Form7.Show
Form32.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form32.Hide
End Sub
Private Sub Command3_Click()
End
End Sub

FORM-33
Private Sub Command1_Click()
'Help for Signs, Signals and Barricades
'-----------------------------------
Form8.Show
Form33.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form33.Hide
End Sub
Private Sub Command3_Click()
End
End Sub

FORM-34
Private Sub Command1_Click()
'Help for Materials Handling, Storage and Use
'-----------------------------------
Form12.Show
Form34.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form34.Hide
End Sub
Private Sub Command3_Click()
FORM-4
Option Explicit
Private Sub Command1_Click()
'Influencing Factors:
'-----------------
```

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```
Form25.Option3(8).Value = False
Form25.Option3(9).Value = False
Form25.Option3(10).Value = False
Form25.Option3(11).Value = False
Form25.Label1.Caption = ""
End
End Sub
FORM-35
Private Sub Command1_Click()
'Help for Welding and Cutting
'-------------------------
Form2.Show
Form35.Hide
End Sub
Private Sub Command2_Click()
Form13.Show
Form35.Hide
End Sub
Private Sub Command3_Click()
End
End Sub

FORM-36
Private Sub Command1_Click()
'Help for Concrete and Concrete Formworks
'-----------------------------------
Form2.Show
Form36.Hide
End Sub
Private Sub Command2_Click()
Form14.Show
Form36.Hide
End Sub
Private Sub Command3_Click()
End
End Sub

FORM-37
Private Sub Command1_Click()
'Help for Crane and Lifting Equipment
'-------------------------------
Form2.Show
Form37.Hide
End Sub
Private Sub Command2_Click()
Form15.Show
Form37.Hide
End Sub
Private Sub Command3_Click()
End
End Sub

FORM-38
Private Sub Command1_Click()
'Help for Chemical Handling
'-------------------------
Form16.Show
Form38.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form38.Hide
'1. Site Planning and Housekeeping
'2. Welfare Facilities
'3. Emergency / Disaster Planning and
Preparation
'4. Signs, Signals and Barricades
'5. Materials Handling, Storage and Use
'-----------------------------------
Form29.Show
Form4.Hide
Private Sub Command2_Click()
Form2.Show
Form4.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'Influencing Factors:
'-------------------
'1. Site Planning and Housekeeping
'2. Welfare Facilities
'3. Emergency / Disaster Planning and
Preparation
'4. Signs, Signals and Barricades
'5. Materials Handling, Storage and Use
End Sub
Private Sub Option1_Click()
Form5.Show
End Sub
Private Sub Option10_Click()
Form61.Show
Form4.Hide
Form4.label2(4).Caption = ""
Form12.Option3(0).Value = False
Form12.Option3(1).Value = False
Form12.Option3(2).Value = False
Form12.Option3(3).Value = False
Form12.Option3(4).Value = False
Form12.Option3(5).Value = False
Form12.Option3(6).Value = False
Form12.Option3(7).Value = False
Form12.Option3(8).Value = False
Form12.Option3(9).Value = False
Form12.Option3(10).Value = False
Form12.Option3(11).Value = False
Form12.Option3(12).Value = False
Form12.Option3(13).Value = False
Form12.Option3(14).Value = False
Form12.Option3(15).Value = False
Form12.Label1.Caption = ""
Form12.label2.Caption = ""
End Sub
Private Sub Option11_Click()
Form5.Show
Form4.Hide
End Sub
Private Sub Option12_Click()
Form6.Show
Form4.Hide
End Sub
Private Sub Option13_Click()
Form7.Show
```

```
End Sub
Private Sub Command3_Click()
End
End Sub

FORM-39
Private Sub Command1_Click()
'Help for Electrical Equipment
'-------------------------
Form17.Show
Form39.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form39.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Form57.Show
Form4.Hide
Form4.label2(0).Caption = ""
Form5.Option3(0).Value = False
Form5.Option3(1).Value = False
Form5.Option3(2).Value = False
Form5.Option3(3).Value = False
Form5.Option3(4).Value = False
Form5.Option3(5).Value = False
Form5.Option3(6).Value = False
Form5.Option3(7).Value = False
Form5.Option3(8).Value = False
Form5.Option3(9).Value = False
Form5.Option3(10).Value = False
Form5.Option3(11).Value = False
Form5.Label1.Caption = ""
Form5.label2.Caption = ""
End Sub
Private Sub Option3_Click()
Form6 Show
End Sub
Private Sub Option4_Click()
Form58.Show
Form4.Hide
Form4.label2(1).Caption = ""
Form6.Option3(0).Value = False
Form6.Option3(1).Value = False
Form6.Option3(2).Value = False
Form6.Option3(3).Value = False
Form6.Option3(4).Value = False
Form6.Option3(5).Value = False
Form6.Option3(6).Value = False
Form6.Option3(7).Value = False
Form6.Option3(8).Value = False
Form6.Option3(9).Value = False
Form6.Option3(10).Value = False
Form6.Option3(11).Value = False
Form6.Option3(12).Value = False
Form6.Option3(13).Value = False
Form6.Option3(14).Value = False
Form6.Option3(15).Value = False
Form6.Option3(16).Value = False
Form6.Option3(17).Value = False
Form4.Hide
End Sub
Private Sub Option14_Click()
Form8.Show
Form4.Hide
End Sub
Private Sub Option15_Click()
Form12.Show
Form4.Hide
End Sub
Private Sub Option2_Click()
Form8.Option3(3).Value = False
Form8.Option3(4).Value = False
Form8.Option3(5).Value = False
Form8.Option3(6).Value = False
Form8.Option3(7).Value = False
Form8.Option3(8).Value = False
Form8.Option3(9).Value = False
Form8.Option3(10).Value = False
Form8.Option3(11).Value = False
Form8.Option3(12).Value = False
Form8.Option3(13).Value = False
Form8.Option3(14).Value = False
Form8.Option3(15).Value = False
Form8.Label1.Caption = ""
Form8.label2.Caption = ""
End Sub
Private Sub Option9_Click()
Form12.Show
End Sub

FORM-40
Private Sub Command1_Click()
'Help for Handling, Transportation
'& Disposal of Hazradous Materials
'-----------------------------------
Form18.Show
Form40.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form40.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'Help for Handling, Transportation
'& Disposal of Hazradous Materials
'-----------------------------------
End Sub

FORM-41
Private Sub Command1_Click()
'Help for Personal Protective Equipment
'-------------------------------------
Form19.Show
Form41.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form41.Hide
```

```
Form6.Option3(18).Value = False
Form6.Option3(19).Value = False
Form6.Label1.Caption = ""
Form6.label2.Caption = ""
End Sub
Private Sub Option5_Click()
Form7.Show
End Sub
Private Sub Option6_Click()
Form59.Show
Form4.Hide
Form4.label2(2).Caption = ""
Form7.Option3(0).Value = False
Form7.Option3(1).Value = False
Form7.Option3(2).Value = False
Form7.Option3(3).Value = False
Form7.Option3(4).Value = False
Form7.Option3(5).Value = False
Form7.Option3(6).Value = False
Form7.Option3(7).Value = False
Form7.Label1.Caption = ""
Form7.label2.Caption = ""
End Sub
Private Sub Option7_Click()
Form8.Show
End Sub
Private Sub Option8_Click()
Form60.Show
Form4.Hide
Form4.label2(3).Caption = ""
Form8.Option3(0).Value = False
Form8.Option3(1).Value = False
Form8.Option3(2).Value = False
'Help for Fire Prevention
'-------------------------
End Sub

FORM-43
Private Sub Command1_Click()
'Help for Transportation
'-------------------------
Form2.Show
Form43.Hide
End Sub
Private Sub Command2_Click()
Form21.Show
Form43.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'Help for Transportation
'-------------------------
End Sub

FORM-44
Private Sub Command1_Click()
'Help for Excavation, Trenching and Shoring
'-----------------------------------------
Form22.Show
Form44.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'Help for Personal Protective Equipment
'-------------------------------------
End Sub

FORM-42
Private Sub Command1_Click()
'Help for Fire Prevention
'-----------------------
Form2.Show
Form42.Hide
End Sub
Private Sub Command2_Click()
Form20.Show
Form42.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()

'Help for Hand and Power Tools
'----------------------------
End Sub

FORM-47
Private Sub Command1_Click()
'Help for Mechanical Equipment
'----------------------------
Form25.Show
Form47.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form47.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'Help for Mechanical Equipment
'----------------------------
End Sub

FORM-48
Private Sub Command1_Click()
'Help for Ionization Radiation
'----------------------------
Form2.Show
Form48.Hide
End Sub
Private Sub Command2_Click()
Form26.Show
Form48.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
```

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```
End Sub
Private Sub Command2_Click()
Form2.Show
Form44.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'Help for Excavation, Trenching and Shoring
'-----------------------------------
End Sub

FORM-45
Private Sub Command1_Click()
'Help for Scaffolding and Ladders
'-----------------------------------
Form23.Show
Form45.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form45.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'Help for Scaffolding and Ladders
'-----------------------------------
End Sub

FORM-46
Private Sub Command1_Click()
'Help for Hand and Power Tools
'-----------------------------------
Form24.Show
Form46.Hide
End Sub
Private Sub Command2_Click()
Form2.Show
Form46.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
Private Sub Command4_Click()
End
End Sub
Private Sub Command5_Click()
t = 0
If text3(0) = "" Then GoTo 10
For i = 0 To 2
t = text3(i).Text + t
Next i
10  If t = 1 Or t = 0 Then
For i = 0 To 3
Form5.Label3(i).Caption = Form5.text3(i).Text
Next i
Else
For i = 0 To 2
Private Sub Form_Load()
'Help for Ionization Radiation
'-----------------------------------
End Sub

FORM-49
Private Sub Command1_Click()
'Help for Management Involvement-1
'-----------------------------------
Form2.Show
Form49.Hide
End Sub
Private Sub Command2_Click()
Form27.Show
Form49.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'Help for Management Involvement-1
'-----------------------------------
End Sub

FORM-5
Private Sub Command1_Click()
Form4.Show
Form5.Hide
Form4.Option11.Value = False
Form4.Option2.Value = False
End Sub
Private Sub Command2_Click()
Form10.Show
Form5.Hide
End Sub
Private Sub Command3_Click()
Form2.Show
Form5.Hide
End Sub
Form2.Show
Form50.Hide
End Sub
Private Sub Command2_Click()
Form28.Show
Form50.Hide
End Sub
Private Sub Command3_Click()
End
End Sub
Private Sub Form_Load()
'Help for Management Involvement-2
'-----------------------------------
End Sub

FORM-51
Private Sub Command2_Click()
'PC-Based Evaluation Tool View /
Print Results Menu
'-----------------
Form2.Show
Form4.Hide
Form51.Hide
```

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```
Form5.Label3(i).Caption = "Error"
Next i
Form65.Show
End If
End Sub
Private Sub Form_Load()
'Site Planning and Housekeeping
'-------------------------------
End Sub
Private Sub Label3_Click(Index As Integer)
updatelabel2
End Sub
Private Sub Option3_Click(Index As Integer)
updatelabel
End Sub
Public Sub updatelabel2()
'For i = 0 To 3
'Form5.Label3(i).Caption = Form5.Text3(i).Text
'Next i
End Sub
Public Sub updatelabel()
'Site Planning and Housekeeping
Dim sp(4)
sp(3) = 0.39
sp(0) = 0.38
sp(1) = 0.35
sp(2) = 0.27
For i = 0 To 3
If Form5.text3(i).Text <> "" Then
sp(i) = Form5.Label3(i).Caption
Else
Form5.Label3(i).Caption = sp(i)
End If
Next i
j = 0
'option
For i = 0 To 11 Step 4
If Option3(i).Value = True Then
spf = sp(j) * 10 + spf
ElseIf Option3(i + 1).Value = True Then
spf = sp(j) * 7 + spf
ElseIf Option3(i + 2).Value = True Then
spf = sp(j) * 5 + spf
ElseIf Option3(i + 3).Value = True Then
spf = sp(j) * 1 + spf
End If
j = j + 1
Next i
Label1.Caption = spf
label2.Caption = spf * Form5.Label3(3).Caption
Form4.label2(0).Caption = spf *
Form5.Label3(3).Caption
End Sub
Public Sub updatelabel2()
'For i = 0 To 3
'Form5.Label3(i).Caption = Form5.Text3(i).Text
'Next i
End Sub
FORM-50
Private Sub Command1_Click()
'Help for Management Involvement-2
'--------------------------------
Form52.Hide
End Sub
Private Sub Command3_Click()
Dim s(20)
Form53.Show
Form53.CurrentX = 0
Form53.CurrentY = 0
Cls
' first main & sub factor (site planning)
Form53.Print Tab(30); "MAIN FACTORS";
Tab(60); "WEIGHT"; Tab(69); "SCORE"
Form53.Print
a = Form4.text2(0).Text
b = Form4.label2(0).Caption
Form53.Print Tab(15); a; Tab(63); b
Form53.Print
' sub factors
For i = 0 To 2
a = Form5.text2(i).Text
b1 = Form5.Label3(i).Caption
If Form5.Option3(j).Value = True Then
b21 = 10
Elself Form5.Option3(j + 1).Value = True Then
b21 = 7
Elself Form5.Option3(j + 2).Value = True Then
b21 = 5
Elself Form5.Option3(j + 3).Value = True Then
b21 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b21
Next i
' end of first factor
'start of welfare factor
Form53.Print
a = Form4.text2(1).Text
b = Form4.label2(1).Caption
Form53.Print Tab(15); a; Tab(63); b
Form53.Print
' sub factors
j = 0
For i = 0 To 4
a = Form6.text2(i).Text
b1 = Form6.Label3(i).Caption
If Form6.Option3(j).Value = True Then
b22 = 10
Elself Form6.Option3(j + 1).Value = True Then
b22 = 7
Elself Form6.Option3(j + 2).Value = True Then
b22 = 5
Elself Form6.Option3(j + 3).Value = True Then
b22 = 1
End If
'end of Materials Handling, Storage & Use
factor
'start of Welding and Cutting factor
Form53.Print
a = Form29.text2(0).Text
b = Form29.label2(0).Caption
c = ""
If b = "" Then c = "N/A"
```

```
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b22
Next i
'end of welfare factor
'start of Emergency/Disaster Planning &
Preparation factor
Form53.Print
a = Form4.text2(2).Text
b = Form4.label2(2).Caption
Form53.Print Tab(15); a; Tab(63); b
Form53.Print
' sub factors
j = 0
For i = 0 To 1
a = Form7.text2(i).Text
b1 = Form7.Label3(i).Caption
If Form7.Option3(j).Value = True Then
b23 = 10
ElseIf Form7.Option3(j + 1).Value = True Then
b23 = 7
ElseIf Form7.Option3(j + 2).Value = True Then
b23 = 5
ElseIf Form7.Option3(j + 3).Value = True Then
b23 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b23
Next i
'end of Emergency/Disaster Planning &
Preparation factor
'start of Signs, Signals & Barricades factor
Form53.Print
a = Form4.text2(3).Text
b = Form4.label2(3).Caption
Form53.Print Tab(15); a; Tab(63); b
Form53.Print
' sub factors
j = 0
For i = 0 To 3
a = Form8.text2(i).Text
b1 = Form8.Label3(i).Caption
If Form8.Option3(j).Value = True Then
b24 = 10
ElseIf Form8.Option3(j + 1).Value = True Then
b24 = 7
ElseIf Form8.Option3(j + 2).Value = True Then
b24 = 5
ElseIf Form8.Option3(j + 3).Value = True Then
b24 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b24
Next i
'end of Signs, Signals & Barricades factor
'start of Materials Handling, Storage & Use
factor
Form53.Print
a = Form4.text2(4).Text
b = Form4.label2(4).Caption
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
If b <> "" Then
' sub factors
j = 0
For i = 0 To 4
a = Form13.text2(i).Text
b1 = Form13.Label3(i).Caption
If Form13.Option3(j).Value = True Then
b26 = 10
ElseIf Form13.Option3(j + 1).Value = True Then
b26 = 7
ElseIf Form13.Option3(j + 2).Value = True Then
b26 = 5
ElseIf Form13.Option3(j + 3).Value = True Then
b26 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b26
Next i
End If
'end of Welding and Cutting factor
'start of Concrete and Concrete Formworks
factor
Form53.Print
a = Form29.text2(1).Text
b = Form29.label2(1).Caption
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
' sub factors
If b <> "" Then
j = 0
For i = 0 To 4
a = Form14.text2(i).Text
b1 = Form14.Label3(i).Caption
If Form14.Option3(j).Value = True Then
b27 = 10
ElseIf Form14.Option3(j + 1).Value = True Then
b27 = 7
ElseIf Form14.Option3(j + 2).Value = True Then
b27 = 5
ElseIf Form14.Option3(j + 3).Value = True Then
b27 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b27
Next i
End If
'end of Concrete and Concrete Formworks
factor
'start of Crane and Lifting Equipment factor
Form53.Print
a = Form29.text2(2).Text
b = Form29.label2(2).Caption
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
' sub factors
If b <> "" Then
j = 0
For i = 0 To 4
```

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```
Form53.Print Tab(15); a; Tab(63); b
Form53.Print
' sub factors
j = 0
For i = 0 To 3
a = Form12.text2(i).Text
b1 = Form12.Label3(i).Caption
If Form12.Option3(j).Value = True Then
b25 = 10
Elself Form12.Option3(j + 1).Value = True Then
b25 = 7
Elself Form12.Option3(j + 2).Value = True Then
b25 = 5
Elself Form12.Option3(j + 3).Value = True Then
b25 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b25
Next i

j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b28
Next i
End If
'end of Crane and Lifting Equipment factor
'start of Chemical Handling factor
Form53.Print
a = Form29.text2(3).Text
b = Form29.label2(3).Caption
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
' sub factors
If b <> "" Then
j = 0
For i = 0 To 2
a = Form16.text2(i).Text
b1 = Form16.Label3(i).Caption
If Form16.Option3(j).Value = True Then
b29 = 10
Elself Form16.Option3(j + 1).Value = True Then
b29 = 7
Elself Form16.Option3(j + 2).Value = True Then
b29 = 5
Elself Form16.Option3(j + 3).Value = True Then
b29 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b29
Next i
'end of Chemical Handling factor
End If
'start of Electrical Equipment factor
Form53.Print
a = Form29.text2(4).Text
b = Form29.label2(4).Caption
Form53.Print Tab(15); a; Tab(63); b
Form53.Print
' sub factors
j = 0
a = Form15.text2(i).Text
b1 = Form15.Label3(i).Caption
If Form15.Option3(j).Value = True Then
b28 = 10
Elself Form15.Option3(j + 1).Value = True Then
b28 = 7
Elself Form15.Option3(j + 2).Value = True Then
b28 = 5
Elself Form15.Option3(j + 3).Value = True Then
b28 = 1
End If
Elself Form18.Option3(j + 3).Value = True Then
b31 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b31
Next i
End If
'end of Handling, Transportation and Disposal
of Hazardous Material and Waste factor
'start of Personal Protective Equipment factor
Form53.Print
a = Form30.text2(1).Text
b = Form30.label2(1).Caption
Form53.Print Tab(15); a; Tab(63); b
Form53.Print
' sub factors
j = 0
For i = 0 To 2
a = Form19.text2(i).Text
b1 = Form19.Label3(i).Caption
If Form19.Option3(j).Value = True Then
b32 = 10
Elself Form19.Option3(j + 1).Value = True Then
b32 = 7
Elself Form19.Option3(j + 2).Value = True Then
b32 = 5
Elself Form19.Option3(j + 3).Value = True Then
b32 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b32
Next i
'end of Personal Protective Equipment factor
'start of Fire Prevention factor
Form53.Print
a = Form30.text2(2).Text
b = Form30.label2(2).Caption
Form53.Print Tab(15); a; Tab(63); b
Form53.Print
' sub factors
j = 0
For i = 0 To 4
a = Form20.text2(i).Text
b1 = Form20.Label3(i).Caption
If Form20.Option3(j).Value = True Then
b33 = 10
Elself Form20.Option3(j + 1).Value = True Then
b33 = 7
Elself Form20.Option3(j + 2).Value = True Then
```

```
For i = 0 To 3
a = Form17.text2(i).Text
b1 = Form17.Label3(i).Caption
If Form17.Option3(j).Value = True Then
b30 = 10
Elself Form17.Option3(j + 1).Value = True Then
b30 = 7
Elself Form17.Option3(j + 2).Value = True Then
b30 = 5
Elself Form17.Option3(j + 3).Value = True Then
b30 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b30
Next i
'end of Electrical Equipment factor
'start of Handling, Transportation and Disposal
of Hazardous Material and Waste factor
Form53.Print
a = Form30.text2(0).Text
b = Form30.label2(0).Caption
c = ""
If b = "" Then c = "N/A"
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
' sub factors
If b <> "" Then
j = 0
For i = 0 To 2
a = Form18.text2(i).Text
b1 = Form18.Label3(i).Caption
If Form18.Option3(j).Value = True Then
b31 = 10
Elself Form18.Option3(j + 1).Value = True Then
b31 = 7
Elself Form18.Option3(j + 2).Value = True Then
b31 = 5
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b34
Next i
'end of Transportation factor
'start of Excavation, Trenching and Shoring
factor
Form53.Print
a = Form30.text2(4).Text
b = Form30.label2(4).Caption
c = ""
If b = "" Then c = "N/A"
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
' sub factors
j = 0
For i = 0 To 2
a = Form22.text2(i).Text
b1 = Form22.Label3(i).Caption
If Form22.Option3(j).Value = True Then
b35 = 10
Elself Form22.Option3(j + 1).Value = True Then
b35 = 7
b33 = 5
Elself Form20.Option3(j + 3).Value = True Then
b33 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b33
Next i
'end of Fire Prevention factor
'start of Transportation factor
Form53.Print
a = Form30.text2(3).Text
b = Form30.label2(3).Caption
Form53.Print Tab(18); a; Tab(63); b
Form53.Print
' sub factors
j = 0
For i = 0 To 4
a = Form21.text2(i).Text
b1 = Form21.Label3(i).Caption
If Form21.Option3(j).Value = True Then
b34 = 10
Elself Form21.Option3(j + 1).Value = True Then
b34 = 7
Elself Form21.Option3(j + 2).Value = True Then
b34 = 5
Elself Form21.Option3(j + 3).Value = True Then
b34 = 1
b37 = 5
Elself Form24.Option3(j + 3).Value = True Then
b37 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b37
Next i
'end of Hand and Power Tools factor
End If
'start of Mechanical Equipment factor
Form53.Print
a = Form31.text2(2).Text
b = Form31.label2(2).Caption
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
' sub factors
If b <> "" Then
j = 0
For i = 0 To 2
a = Form25.text2(i).Text
b1 = Form25.Label3(i).Caption
If Form25.Option3(j).Value = True Then
b38 = 10
Elself Form25.Option3(j + 1).Value = True Then
b38 = 7
Elself Form25.Option3(j + 2).Value = True Then
b38 = 5
Elself Form25.Option3(j + 3).Value = True Then
b38 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b38
```

```
ElseIf Form22.Option3(j + 2).Value = True Then
b35 = 5
ElseIf Form22.Option3(j + 3).Value = True Then
b35 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b35
Next i
'end of Excavation, Trenching and Shoring
factor
'start of Scaffolding and Ladders factor
Form53.Print
a = Form31.text2(0).Text
b = Form31.label2(0).Caption
c = ""
If b = "" Then c = "N/A"
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
' sub factors
If b <> "" Then
j = 0
For i = 0 To 3
a = Form23.text2(i).Text
b1 = Form23.Label3(i).Caption
If Form23.Option3(j).Value = True Then
b36 = 10
ElseIf Form23.Option3(j + 1).Value = True Then
b36 = 7
ElseIf Form23.Option3(j + 2).Value = True Then
b36 = 5
ElseIf Form23.Option3(j + 3).Value = True Then
b36 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b36
Next i
'end of Scaffolding and Ladders factor
End If
'start of Hand and Power Tools factor
Form53.Print
a = Form31.text2(1).Text
b = Form31.label2(1).Caption
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
' sub factors
If b <> "" Then
j = 0
For i = 0 To 2
a = Form24.text2(i).Text
b1 = Form24.Label3(i).Caption
If Form24.Option3(j).Value = True Then
b37 = 10
ElseIf Form24.Option3(j + 1).Value = True Then
b37 = 7
ElseIf Form24.Option3(j + 2).Value = True Then
ElseIf Form27.Option3(j + 2).Value = True Then
b40 = 5
ElseIf Form27.Option3(j + 3).Value = True Then
b40 = 1
End If
Next i
'end of Mechanical Equipment factor
End If
'start of Ionizing Radiation factor
Form53.Print
a = Form31.text2(3).Text
b = Form31.label2(3).Caption
Form53.Print Tab(15); a; Tab(63); b; c
Form53.Print
' sub factors
If b <> "" Then
j = 0
For i = 0 To 4
a = Form26.text2(i).Text
b1 = Form26.Label3(i).Caption
If Form26.Option3(j).Value = True Then
b39 = 10
ElseIf Form26.Option3(j + 1).Value = True Then
b39 = 7
ElseIf Form26.Option3(j + 2).Value = True Then
b39 = 5
ElseIf Form26.Option3(j + 3).Value = True Then
b39 = 1
End If
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b39
Next i
End If
'end of Ionizing Radiation factor
'start of Management Involvement factor
Form53.Print
a = Form31.text2(4).Text
b = Form31.label2(4).Caption
Form53.Print Tab(15); a; Tab(63); b
Form53.Print
' sub factors
j = 0
For i = 0 To 5
a = Form27.text2(i).Text
b1 = Form27.Label3(i).Caption
If Form27.Option3(j).Value = True Then
b40 = 10
ElseIf Form27.Option3(j + 1).Value = True Then
b40 = 7
factdel = factdel + 5
End If
If Form31.Option2.Value = True Then
factdel = factdel + 5.6
End If
If Form31.Option4.Value = True Then
factdel = factdel + 3.8
End If
If Form31.Option6.Value = True Then
factdel = factdel + 5
End If
If Form31.Option8.Value = True Then
factdel = factdel + 5.7
End If
ss = ss * 100 / (100 - factdel)
' end of add
```

PC-BASED EVALUATION TOOL CODES

```
j = j + 4
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b40
Next i
'end of Management Involvement factor
'start of Management Involvement factor
'Form53.Print
'a = Form31.text2(4).Text
'b = Form31.label2(4).Caption
'Form53.Print Tab(15); a; Tab(63); b
'Form53.Print
' sub factors
j = 0
For i = 0 To 4
a = Form28.text2(i).Text
b1 = Form28.Label3(i).Caption
If Form28.Option3(j).Value = True Then
b41 = 10
Elself Form28.Option3(j + 1).Value = True Then
b41 = 7
Elself Form28.Option3(j + 2).Value = True Then
b41 = 5
Elself Form28.Option3(j + 3).Value = True Then
b41 = 1
End If
j = j + 3
Form53.Print Tab(18); a; Tab(63); b1; Tab(70);
b41
Next i
'end of Management Involvement factor
' adding total
ss = 0
For j = 0 To 4
If Form4.label2(j).Caption <> "" Then
s(j) = Form4.label2(j).Caption
ss = s(j) + ss
End If
Next j
For j = 0 To 4
If Form29.label2(j).Caption <> "" Then
s(j) = Form29.label2(j).Caption
ss = s(j) + ss
End If
Next j
For j = 0 To 4
If Form30.label2(j).Caption <> "" Then
s(j) = Form30.label2(j).Caption
ss = s(j) + ss
End If
Next j
For j = 0 To 4
If Form31.label2(j).Caption <> "" Then
s(j) = Form31.label2(j).Caption
ss = s(j) + ss
End If
Next j
factdel = 0
If Form29.Option2.Value = True Then
factdel = factdel + 4.7
End If
If Form29.Option4.Value = True Then
factdel = factdel + 4.6
Form53.Print
Form53.Print
Form53.Print
Form53.Print Tab(15); "SAFTEY
PERFORMANCE = "; Tab(40); ss
End Sub
Private Sub Command8_Click()
End
End Sub
Private Sub printmain_Click()
'PC-Based Evaluation Tool's View / Print
Results Menu
'-----------------------------------------------
---
Dim s(20)
Form52.Show
Form52.CurrentX = 0
Form52.CurrentY = 0
Cls
Form52.Print Tab(15); " MAIN FACTORS";
Tab(67); "RESULTS"
Form52.Print
Form52.Print
For i = 0 To 4
a = Form4.text2(i).Text
b = Form4.label2(i).Caption
Form52.Print Tab(15); a; Tab(70); b
Next i
For i = 0 To 4
a = Form29.text2(i).Text
b = Form29.label2(i).Caption
c = ""
If b = "" Then c = "N/A"
Form52.Print Tab(15); a; Tab(70); b; c
Next i
For i = 0 To 4
a = Form30.text2(i).Text
b = Form30.label2(i).Caption
c = ""
If b = "" Then c = "N/A"
Form52.Print Tab(15); a; Tab(70); b; c
Next i
For i = 0 To 4
a = Form31.text2(i).Text
b = Form31.label2(i).Caption
c = ""
If b = "" Then c = "N/A"
Form52.Print Tab(15); a; Tab(70); b; c
Next i
' adding total
ss = 0
For j = 0 To 4
If Form4.label2(j).Caption <> "" Then
s(j) = Form4.label2(j).Caption
ss = s(j) + ss
End If
Next j
For j = 0 To 4
If Form29.label2(j).Caption <> "" Then
s(j) = Form29.label2(j).Caption
ss = s(j) + ss
End If
```

PC-BASED EVALUATION TOOL CODES

```
End If
If Form29.Option6.Value = True Then
factdel = factdel + 5.6
End If
If Form29.Option8.Value = True Then
factdel = factdel + 4.9
End If
If Form30.Option2.Value = True Then
factdel = factdel + 4.6
End If
If Form30.Option10.Value = True Then
Next j
For j = 0 To 4
If Form30.label2(j).Caption <> "" Then
s(j) = Form30.label2(j).Caption
ss = s(j) + ss
End If
Next j
For j = 0 To 4
If Form31.label2(j).Caption <> "" Then
s(j) = Form31.label2(j).Caption
ss = s(j) + ss
End If
Next j
factdel = 0
If Form29.Option2.Value = True Then
factdel = factdel + 4.7
End If
If Form29.Option4.Value = True Then
factdel = factdel + 4.6
End If
If Form29.Option6.Value = True Then
factdel = factdel + 5.6
End If
If Form29.Option8.Value = True Then
factdel = factdel + 4.9
End If
If Form30.Option2.Value = True Then
factdel = factdel + 4.6
End If
If Form30.Option10.Value = True Then
factdel = factdel + 5
End If
If Form31.Option2.Value = True Then
factdel = factdel + 5.6
End If
If Form31.Option4.Value = True Then
factdel = factdel + 3.8
End If
If Form31.Option6.Value = True Then
factdel = factdel + 5
End If
If Form31.Option8.Value = True Then
factdel = factdel + 5.7
End If
ss = ss * 100 / (100 - factdel)
' end of add
Form52.Print
Form52.Print
Form52.Print
If ss >= 90 Then
perf = "EXCELLENT"
```

```
'Main Factors View / Print Results
'-------------------------
Dim s(20)
' printing project data
Printer.Print
Printer.Print
Printer.Print
Printer.Print
Printer.Print
Printer.Print
Printer.Print Tab(30); Form3.Text1.Text
Printer.Print
Printer.Print
Printer.Print
Printer.Print
Printer.Print
Printer.Print Tab(15); Form3.text2.Text; Tab(40);
Form3.text3.Text
Printer.Print Tab(15); Form3.Text4.Text; Tab(40);
Form3.Text7.Text
Printer.Print Tab(15); Form3.Text5.Text; Tab(40);
Form3.Text8.Text
Printer.Print Tab(15); Form3.Text6.Text; Tab(40);
Form3.Text9.Text
Printer.Print
Printer.Print
Printer.Print
Printer.Print Tab(30); "MAIN FACTORS";
Tab(67); "RESULTS"
Printer.Print
Printer.Print
For i = 0 To 4
a = Form4.text2(i).Text
b = Form4.label2(i).Caption
Printer.Print Tab(15); a; Tab(70); b
Next i
For i = 0 To 4
a = Form29.text2(i).Text
b = Form29.label2(i).Caption
c = ""
If b = "" Then c = "N/A"
Printer.Print Tab(15); a; Tab(70); b; c
Next i
For i = 0 To 4
a = Form30.text2(i).Text
b = Form30.label2(i).Caption
c = ""
If b = "" Then c = "N/A"
Printer.Print Tab(15); a; Tab(70); b; c
Next i
For i = 0 To 4
a = Form31.text2(i).Text
b = Form31.label2(i).Caption
c = ""
If b = "" Then c = "N/A"
Printer.Print Tab(15); a; Tab(70); b; c
Next i
' adding total
ss = 0
For j = 0 To 4
If Form4.label2(j).Caption <> "" Then
s(j) = Form4.label2(j).Caption
```

PC-BASED EVALUATION TOOL CODES

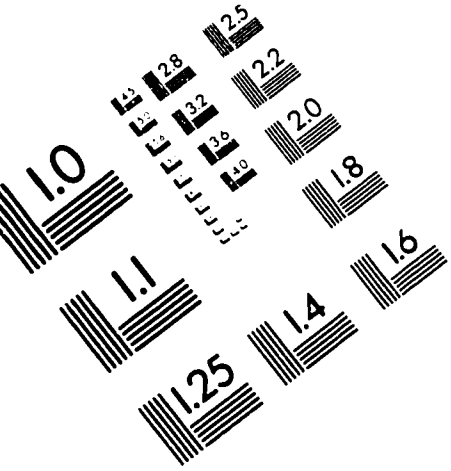
```
Elself ss >= 80 Then
perf = "GOOD"
Elself ss >= 70 Then
perf = "FAIR"
Elself ss >= 60 Then
perf = "POOR"
Elself ss < 60 Then
perf = "INADEQUATE"
End If
Form52.Print Tab(15); "SAFETY
PERFORMANCE = "; Tab(40);
Form52.Print Format$(ss, "###.#"); Tab(45); perf;
" PERFORMANCE"
End Sub

FORM-52
Private Sub Command1_Click()
'Main Factors View / Print Results
Form51.Show
Form52.Hide
End Sub
Private Sub Command2_Click()
End
End Sub
Private Sub printmain_Click()
Next j
For j = 0 To 4
If Form31.label2(j).Caption <> "" Then
s(j) = Form31.label2(j).Caption
ss = s(j) + ss
End If
Next j
factdel = 0
If Form29.Option2.Value = True Then
factdel = factdel + 4.7
End If
If Form29.Option4.Value = True Then
factdel = factdel + 4.6
End If
If Form29.Option6.Value = True Then
factdel = factdel + 5.6
End If
If Form29.Option8.Value = True Then
factdel = factdel + 4.9
End If
If Form30.Option2.Value = True Then
factdel = factdel + 4.6
End If
If Form30.Option10.Value = True Then
factdel = factdel + 5
End If
If Form31.Option2.Value = True Then
factdel = factdel + 5.6
End If
If Form31.Option4.Value = True Then
factdel = factdel + 3.8
End If
If Form31.Option6.Value = True Then
factdel = factdel + 5
End If
If Form31.Option8.Value = True Then
ss = s(j) + ss
End If
Next j
For j = 0 To 4
If Form29.label2(j).Caption <> "" Then
s(j) = Form29.label2(j).Caption
ss = s(j) + ss
End If
Next j
For j = 0 To 4
If Form30.label2(j).Caption <> "" Then
s(j) = Form30.label2(j).Caption
ss = s(j) + ss
End If
Private Sub printmain_Click()
'Sub-Factors View / Print Results
'-------------------------------
Dim s(20)
' printing project data
Printer.Print
Printer.Print
Printer.Print
Printer.Print Tab(30); Form3.Text1.Text
Printer.Print
Printer.Print
Printer.Print
Printer.Print
Printer.Print
Printer.Print Tab(15); Form3.text2.Text; Tab(40);
Form3.text3.Text
Printer.Print Tab(15); Form3.Text4.Text; Tab(40);
Form3.Text7.Text
Printer.Print Tab(15); Form3.Text5.Text; Tab(40);
Form3.Text8.Text
Printer.Print Tab(15); Form3.Text6.Text; Tab(40);
Form3.Text9.Text
Printer.Print
' first main & sub factor (site planning)
Printer.Print Tab(30); "MAIN FACTOR";
Tab(60); "WEIGHT"; Tab(67); "SCORE"
Printer.Print
a = Form4.text2(0).Text
b = Form4.label2(0).Caption
Printer.Print Tab(15); a; Tab(63); b
Printer.Print
' sub factors
For i = 0 To 2
a = Form5.text2(i).Text
b1 = Form5.Label3(i).Caption
If Form5.Option3(j).Value = True Then
b21 = 10
Elself Form5.Option3(j + 1).Value = True Then
b21 = 7
Elself Form5.Option3(j + 2).Value = True Then
b21 = 5
Elself Form5.Option3(j + 3).Value = True Then
b21 = 1
End If
j = j + 4
Printer.Print Tab(18); a; Tab(63); b1; Tab(70); b21
Next i
' end of first factor
```

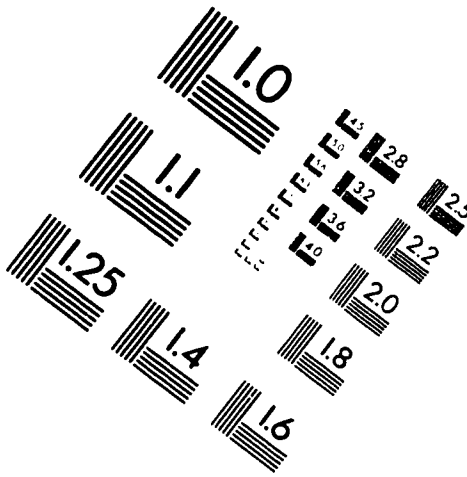
PC-BASED EVALUATION TOOL CODES

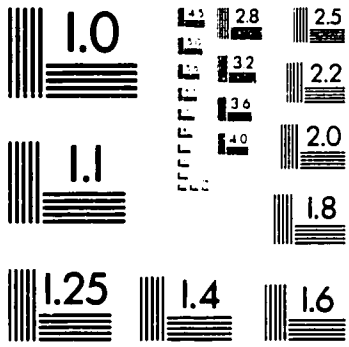
```
factdel = factdel + 5.7
End If
ss = ss * 100 / (100 - factdel)
' end of add
Printer.Print
Printer.Print
Printer.Print
Printer.Print
Printer.Print
Printer.Print
If ss >= 90 Then
perf = "EXCELLENT"
Elself ss >= 80 Then
perf = "GOOD"
Elself ss >= 70 Then
perf = "FAIR"
Elself ss >= 60 Then
perf = "POOR"
Elself ss < 60 Then
perf = "INADEQUATE"
End If
Printer.Print Tab(15); "SAFETY
PERFORMANCE = "; Tab(40);
Printer.Print Format$(ss, "###.#"); Tab(45); perf; "
PERFORMANCE"
Printer.EndDoc
End Sub

FORM-53
Private Sub Command1_Click()
Form51.Show
Form53.Hide
End Sub
Private Sub Command2_Click()
End
End Sub
Private Sub Command3_Click()
Form53.Hide
Form2.Show
End Sub
Printer.Print Tab(15); a; Tab(63); b
Printer.Print
' sub factors
j = 0
For i = 0 To 1
a = Form7.text2(i).Text
b1 = Form7.Label3(i).Caption
If Form7.Option3(j).Value = True Then
b23 = 10
Elself Form7.Option3(j + 1).Value = True Then
b23 = 7
Elself Form7.Option3(j + 2).Value = True Then
b23 = 5
Elself Form7.Option3(j + 3).Value = True Then
b23 = 1
End If
j = j + 4
Printer.Print Tab(18); a; Tab(63); b1; Tab(70);
b23
Next i
'end of Emergency/Disaster Planning &
'start of welfare factor
Printer.Print
a = Form4.text2(1).Text
b = Form4.label2(1).Caption
Printer.Print Tab(15); a; Tab(63); b
Printer.Print
' sub factors
j = 0
For i = 0 To 4
a = Form6.text2(i).Text
b1 = Form6.Label3(i).Caption
If Form6.Option3(j).Value = True Then
b22 = 10
Elself Form6.Option3(j + 1).Value = True Then
b22 = 7
Elself Form6.Option3(j + 2).Value = True Then
b22 = 5
Elself Form6.Option3(j + 3).Value = True Then
b22 = 1
End If
j = j + 4
Printer.Print Tab(18); a; Tab(63); b1; Tab(70); b22
Next i
'end of welfare factor
'start of Emergency/Disaster Planning &
Preparation factor
Printer.Print
a = Form4.text2(2).Text
b = Form4.label2(2).Caption
If b <> "" Then
' sub factors
j = 0
For i = 0 To 4
a = Form13.text2(i).Text
b1 = Form13.Label3(i).Caption
If Form13.Option3(j).Value = True Then
b26 = 10
Elself Form13.Option3(j + 1).Value = True Then
b26 = 7
Elself Form13.Option3(j + 2).Value = True Then
b26 = 5
Elself Form13.Option3(j + 3).Value = True Then
b26 = 1
End If
j = j + 4
Printer.Print Tab(18); a; Tab(63); b1; Tab(70); b26
Next i
'end of Welding and Cutting factor
End If
'start of Concrete and Concrete Formworks
factor
Printer.Print
Printer.Print
a = Form29.text2(1).Text
b = Form29.label2(1).Caption
Printer.Print
'Printer.Print Tab(30); "MAIN FACTOR";
Tab(60); "WEIGHT"; Tab(67); "SCORE"
'Printer.Print
Printer.Print Tab(15); a; Tab(63); b; c
Printer.Print
If b <> "" Then
```

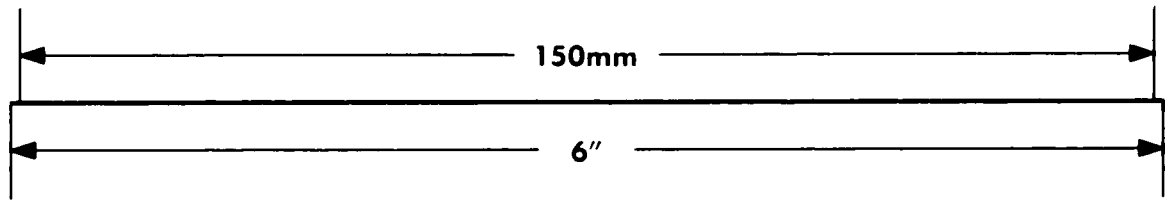
PC-BASED EVALUATION TOOL CODES

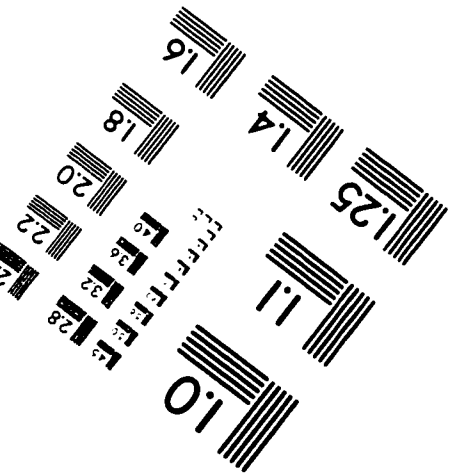
IMAGE EVALUATION
TEST TARGET (QA-3)

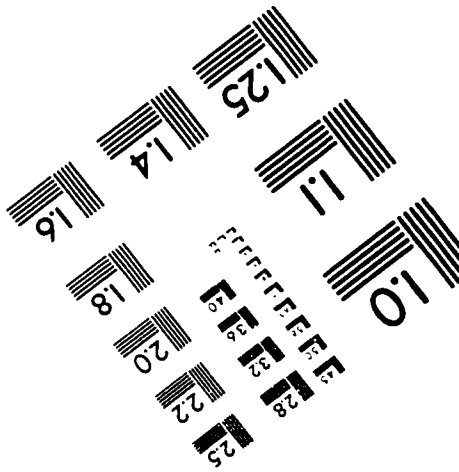












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